THE VALUE OF WATER:

A framework for understanding water valuation, risk and stewardship

DISCUSSION DRAFT | August 2015

AUTHORS | Alexis J. Morgan and Stuart Orr (WWF International)

WWF

IFC International Finance Corporation
WORLD BANK GROUP

COVER PHOTOS
LEFT: A girl pumps water in Zimbabwe. **PHOTO CREDIT:** Curt Carnemark / World Bank
RIGHT: The renovated water treatment plant in Juba South Sudan. **PHOTO CREDIT:** Arne Hoel / World Bank

TABLE OF CONTENTS

The people in Woukpokpoe village have benefited greatly from Benin's national CDD project. They now have access to safe, clean water.
PHOTO CREDIT: Arne Hoel / World Bank

EXECUTIVE SUMMARY

WHY DOES THE VALUE OF WATER MATTER?

Water is arguably the most precious resource on Earth, and yet we often value and manage it extremely poorly. The price of water traditionally reflects a limited set of costs to treat and transport water, but the value of water is far greater. Low and subsidized water prices are important to ensure the human right to water is met, and yet water's low market-based cost has resulted in profligate use, freshwater contamination and, in general, inflicted costs upon society and nature. Furthermore, for business, the skewed market-based value of water has resulted in losses to shareholder value.

The value of water is difficult to quantify because different audiences conceptualize and describe its values differently. The private sector tends to use the language of finance, while governments often employ concepts from economics and civil society, using a range of environmental, rights-based, or social-goods language for valuing water. All of the stakeholders have a legitimate claim on water and its use, and so a corporate perspective must both understand and negotiate these different ways of valuing water as a scarce resource.

This report seeks to bring clarity to a corporate audience, as well as other relevant stakeholders, on how to better understand water valuation, water risks, and the possibilities for better water stewardship. After an introduction, Part 2 discusses current valuation practices to date and their limitations. Part 3 then presents a new framework for valuing water. Part 4 uses that framework to help corporates to better account for water's true value. Part 5 looks at current tools and case studies to using the new framework to better understand the field. Highlights of the key sections are as follows:

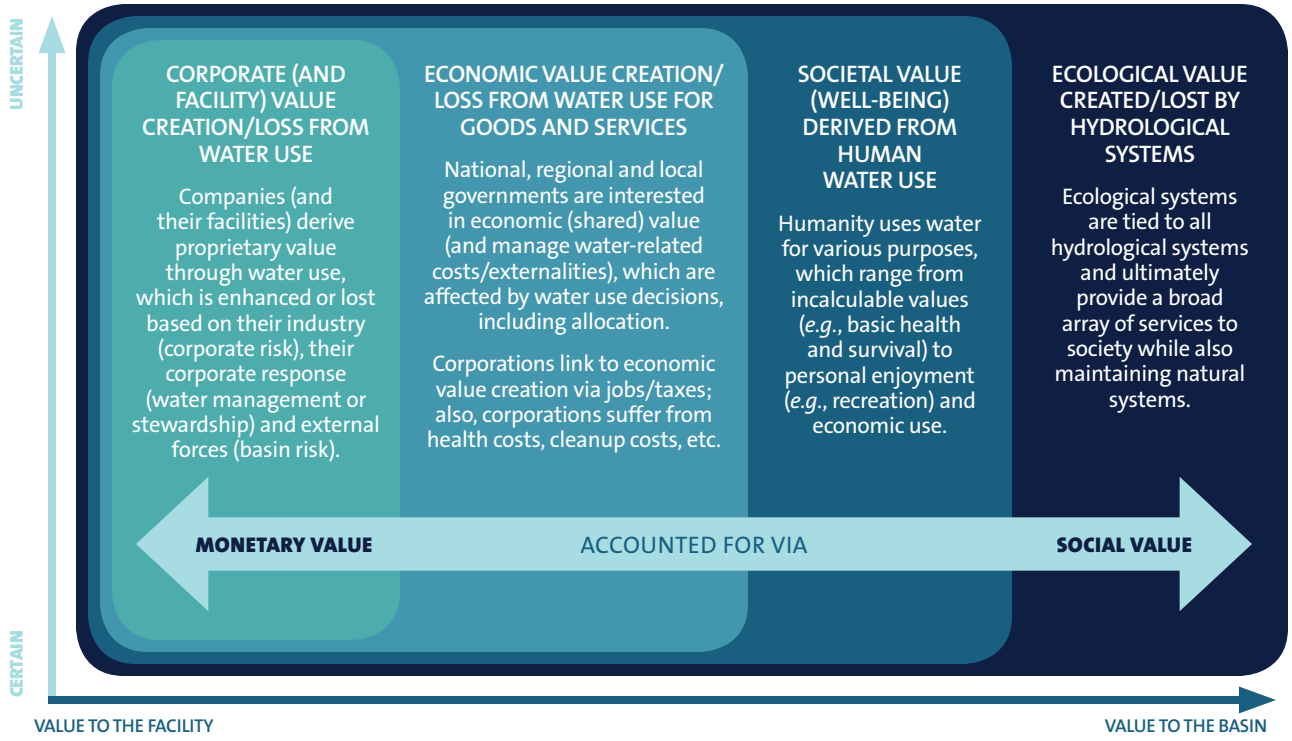
Section 1. Introduction

Section 1 lays out the basic context for the report and the basic components to be discussed.

Section 2. Varying perspectives and the need for clarity

Section 2 looks at the field of water valuation to give context to the report. The section begins by looking at how the private sector, government, and civil society value water differently. The section then progresses to look at two key often-mistaken terms:

FIGURE A. **The value of water to a company, the economy, society and nature**



"Water Valuation" and "Water at Risk." The section concludes by looking at the strengths and limitations of two current valuation tools: The WBCSD Water Valuation Framework and the Total Economic Valuation (TEV) framework.

Section 3. New Water Valuation Framework

Section 3 proposes a new water valuation framework in light of recent focus on water risk and water stewardship. Water is valued differently by the private sector, governments, and civil society as seen in the figure below. Each stakeholder has a different language or discipline to talk about the value of water from finance to economics to others. Furthermore, corporate water value is nested within economic, social and ecological water value. It is also able to distinguish between the price, cost and value of water, since a focus on the former two (especially price) results in significant undervaluation of water in corporate decision making..

Water valuation is linked to uncertainty (*i.e.*, water risk), which manifests at various scales and is informed by different disciplines using different audience-specific methodologies. Both time and space are linked to water value (see Figure B). To effectively communicate water value, it is key to understand which fields (*e.g.*, finance, economics, etc.) are relevant to your audience and how those fields are impacted by uncertainty.

Water stewardship is a form of water risk mitigation that seeks to preserve and create value at multiple scales and levels of certainty. A more traditional, limited water management response, as seen in Figure C, focuses on a narrow range of current facility and corporate value elements (largely current cost), only partly addresses corporate water risks, and largely ignores basin-level risk mitigation or value creation. Unlike traditional water management, water stewardship helps to maximize long-term shareholder value (as well as social value). Companies are therefore encouraged to push their response efforts, via water stewardship, to the right and top of the valuation framework to maximize water value.

Section 4. Comprehensive metrics to understand how water affects shareholder value

Section 4 looks at how the private sector can comprehensively take into account how water affects corporate shareholder value and use this information to inform their management practices and demonstrate value creation and preservation to their various audiences (from shareholders to local communities). The measures derive from the valuation framework and are structured around a modified income statement and balance sheet (as seen in Figures D and E). Employed together, they outline not only how facilities can better measure how water

FIGURE B. How valuation is affected by uncertainty

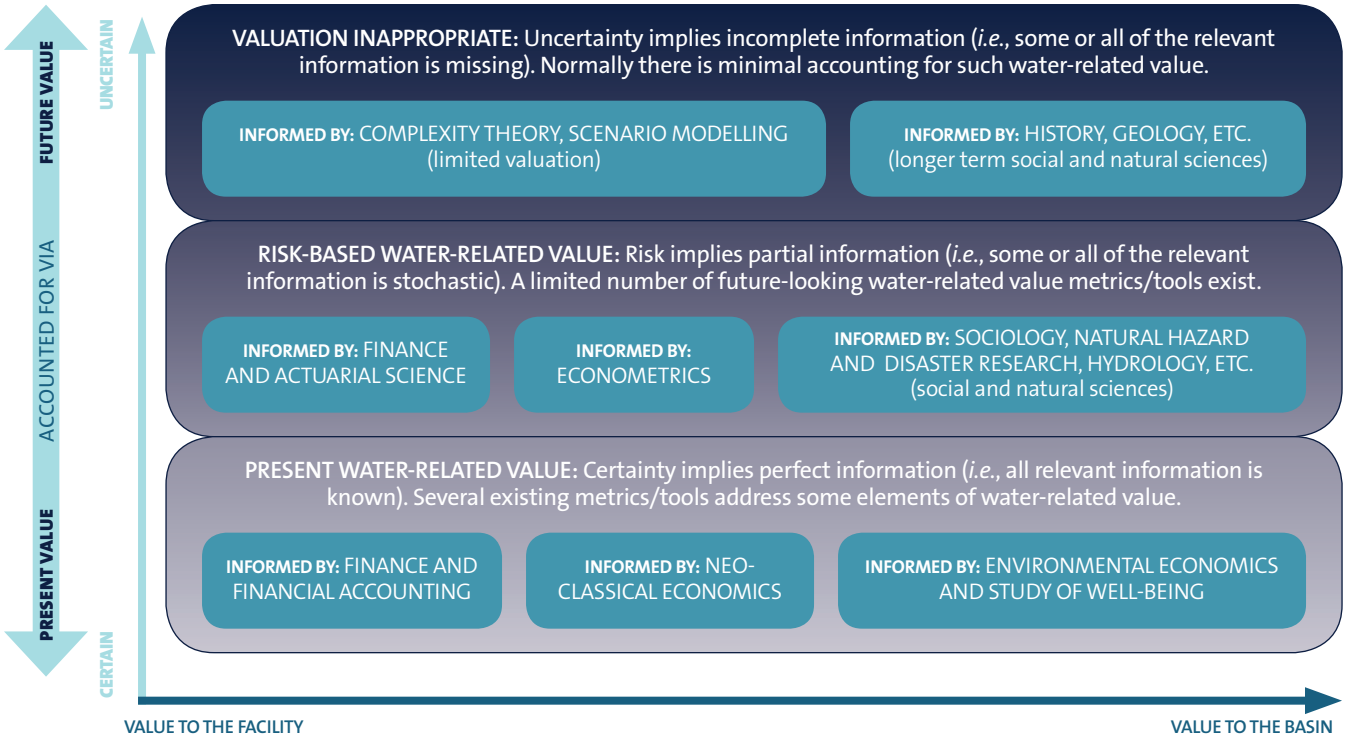
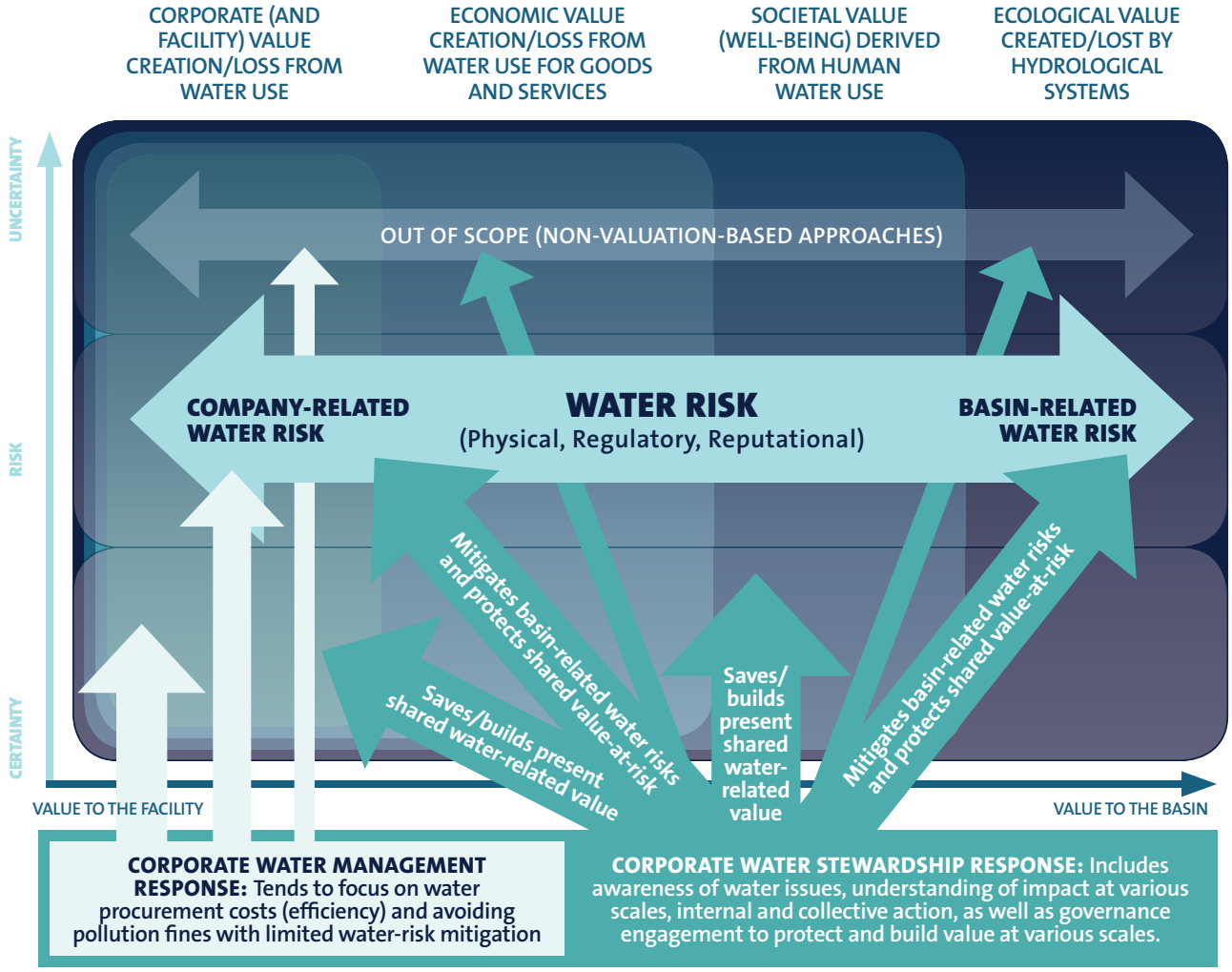


FIGURE C. **Overlaying corporate management and stewardship**



affects costs, revenues, assets and liabilities, but also provide a template for companies to demonstrate how water stewardship can deliver (and document) shareholder and stakeholder value in an accessible format.

In undertaking a more robust approach to water valuation that is consistent with existing financial accounting methods, not only are managers able to identify areas to increase shareholder value, but they are also better able to demonstrate how they are contributing to social value creation (or mitigating social value loss) through the enhancement or preservation of public assets. This tracking enables companies to strengthen community relations and thereby mitigate reputational and regulatory water risks. Therefore while the right side of the above figures (value to the basin) is not currently accounted for on balance sheets or income statements, tracking broader-scale water-value elements still enables improved management.

Section 5. Exploring water tools and case studies using the Water Valuation Framework

Section 5 explores how some of the existing water valuation tools account for the water valuation elements as outlined in the report. This mapping exercise indicates a significant number of gaps in the efforts to date to fully capture the value of water and provides a template for an improved pathway forward to improve water valuation. Nearly 40 different water valuation case studies were gathered and then mapped onto the framework to determine which areas of water valuation are receiving the majority of the attention. Unsurprisingly, the majority of efforts to date have focused on cost-savings (via traditional efficiency-minded water management), along with some focus on impacts to sales.

The key conclusion from the assessment of existing efforts is that while there are numerous methods and tools applied to

FIGURE D. A balance sheet perspective of water valuation

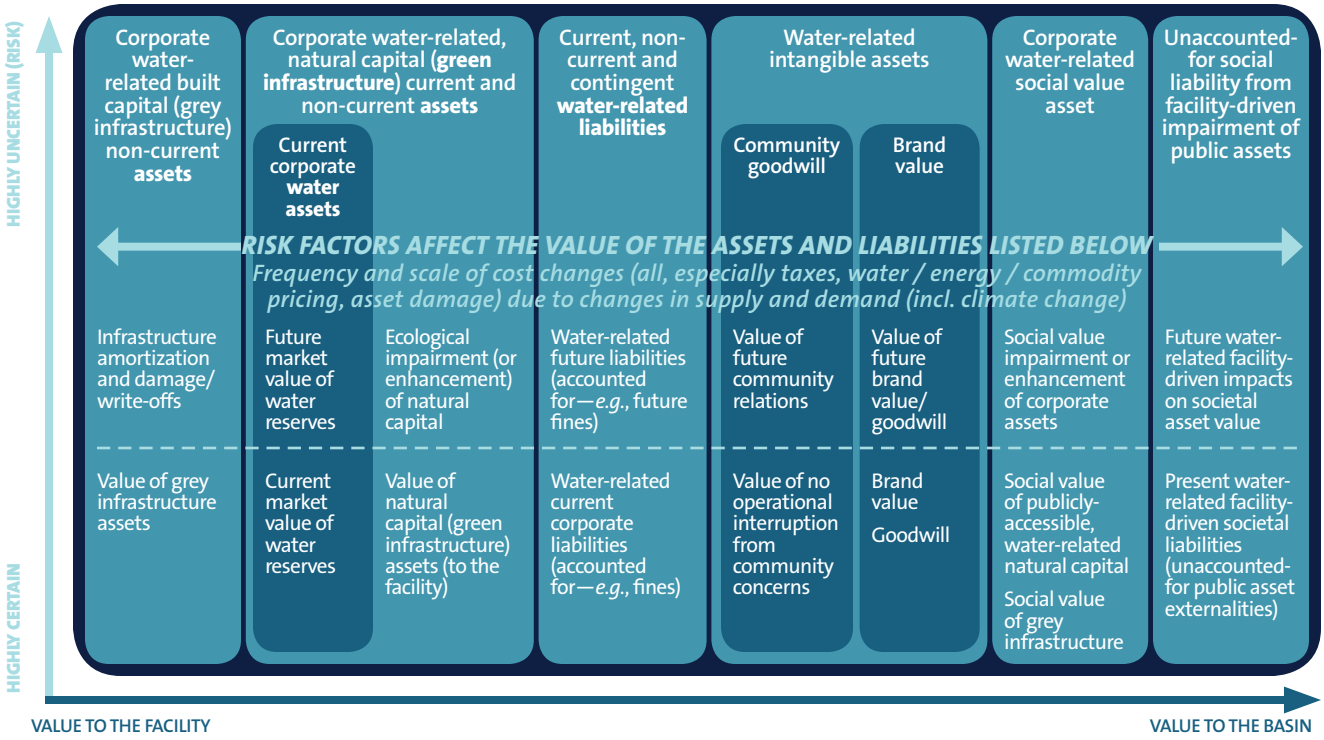
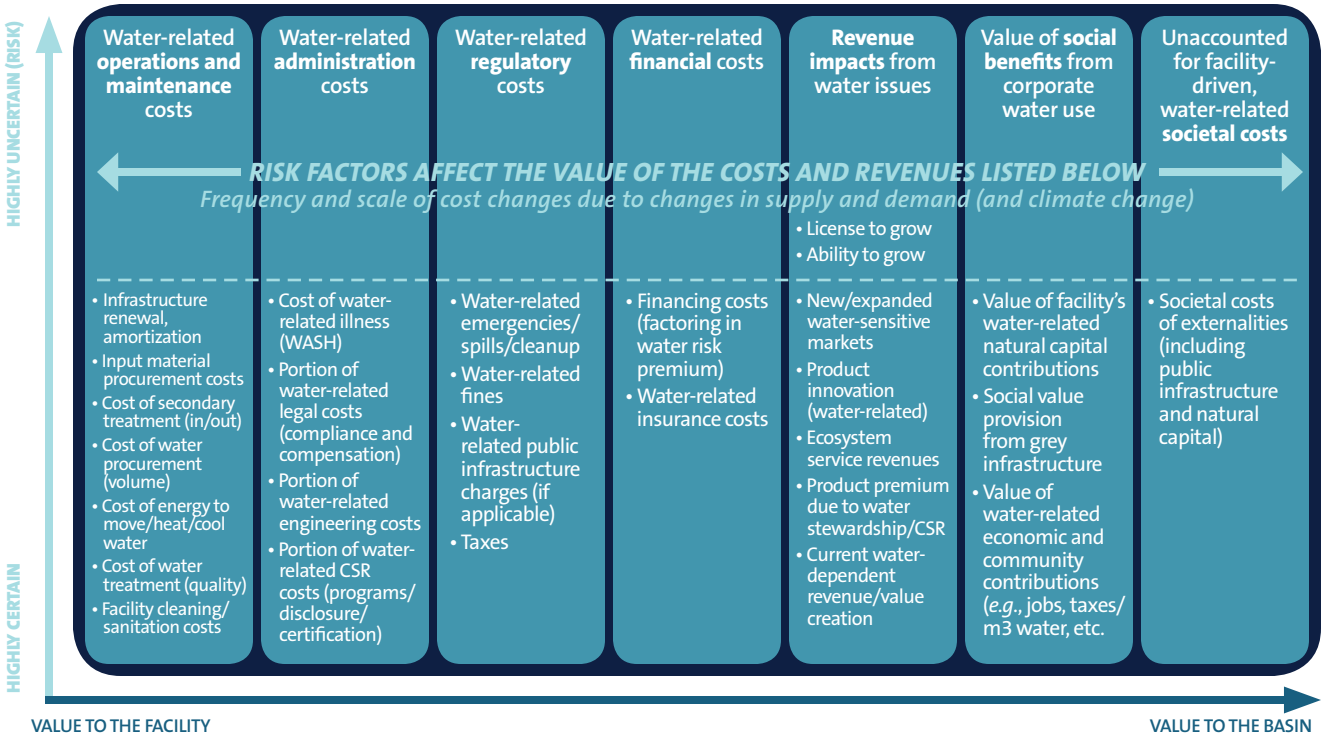


FIGURE E. An income statement perspective of water valuation



the sphere of water valuation, to date, no water valuation tool has been entirely comprehensive while also remaining practical for business. Furthermore, case studies suggest that business continues to focus on operational savings and immediate revenue impacts, which are only a limited portion of the water-related value. Other aspects of water value appear to receive far less attention, such as water-related administrative costs, value in natural capital assets, financial risk premiums, future ability to operate/grow, and product innovation.

RECOMMENDATIONS

Based on the above three sections and insight gained, the paper then concludes with a number of recommendations for companies:

1. **Understand water's value to different audiences.**
   Understand how water creates value for different audiences, and employ appropriate metrics for appropriate audiences. In particular, pay attention to corporate-controlled natural capital assets which *may* hold material future value to corporate audiences, and *do* provide present value to society (as well as also affect present brand value). Furthermore, understand your impacts and dependencies on publicly-controlled natural capital assets and take advantage of standardized approaches such as the Natural Capital Protocol.

2. **Understand how risk and uncertainty impacts the value of water.**
   Understand how variables and potentially changing conditions impact the future value of water. Consider how basin and corporate water risks affect the value of your facilities and your company. If you have not already done so, conduct a water risk assessment of the portfolio of your operations to understand water-related materiality.

3. **Include water-related value in your balance sheet and income statement and discuss both water risk and stewardship response in your annual report.**
   Account for water-related assets beyond grey infrastructure; for the estimated future value of groundwater reserves; for the value of green infrastructure; and for the value of the intangible social capital (community relations/brand value) that relates to reputational risk. Select measures that are important to key internal and external audiences, and use these metrics to build better business cases for water stewardship.

4. **When making financial decisions, consider more than just the price of water.**
   Ensure the tools and methods used in various ways in which water affects costs and revenues across operations and maintenance, administration, regulations, and finance.

5. **Learn about, and engage in, water stewardship to more fully capture water-related value.**
   Traditional water management with its focus on water prices not only leaves value on the table, but it can also further exacerbate risks and erode long-term value at multiple scales.

6. **Share with investors how water stewardship creates and preserves value.**
   In your annual report, communicate with shareholders about how you are undertaking water risk assessments to maximize shareholder value through water stewardship.

WWF and IFC believe the water valuation framework and the insights from this report provide a key missing piece to date: connecting water to shareholder value, water risk and water stewardship. Both IFC and WWF will continue to be active in this space and are committed to exploring opportunities to enhance existing tools to ensure they meet business and societal needs. We invite and encourage companies to begin to employ the framework and metrics outlined here to take action on water for society and nature, while simultaneously benefitting their bottom lines. Ultimately, improved accounting for the value of water benefits shareholders, local economies, societal well-being, and helps to ensure the health of freshwater ecosystems.

Worker at waster water treatment facility. Manila, Philippines. **CREDIT:** Danilo Pinzon / World Bank

1 | INTRODUCTION

Around the world, from developing to industrialized countries, water availability and quality is an ever increasing challenge. The World Economic Forum now ranks water as the greatest risk impacting the world's economy—reflecting private sector concern over waters ability to affect material risk. Water is a precious resource that needs to be better managed for survival and growth.

Beyond business, water is perceived by different audiences as a commodity with a market value, a social good, an environmental integrity underpinning, and/or a fundamental human right. Governments increasingly recognize the importance of water in the economy for traditional growth, as well as ecosystem services and the costs of poor water management, in particular on human health. Civil society values water for basic health and sanitation concerns, as well as for spiritual and recreational reasons. In short, as water resources have come under increasing pressure, there is a growing interest to better understand water from both risk and the valuation perspectives.

Despite the urgent need for a shared discussion on the value of water, stakeholders often talk past one another when discussing its importance. The concepts of the price of water, the cost of water, and the value of water are often used interchangeably when in reality, they differ considerably. Value can be monetary as well as social (*i.e.*, non-monetary). Value can be proprietary to a single water user (*e.g.*, a farm or a factory) or shared amongst many water users within a river basin.

Different audiences also employ different disciplines to engage in valuation: The language and approaches employed in finance provides valuation approaches that resonate for corporate managers and investors. Conversely, the field of economics sees valuation at a larger societal (often national to local government) level to understand how water is employed to create value through the production, distribution and consumption of goods and services. Finally, emerging research and disciplines explore less tangible concepts such as happiness and well-being, and explore the social value of numerous elements in our world. The result is that various tools, methods, and disciplines have created a degree of confusion in the landscape of water valuation.

Creating the right incentives for people, governments and businesses to better value water, and, in turn, ensure that markets recognize shareholder value creation through water stewardship responses will require many strategies. There has to be a shift from traditional market-based water pricing that undervalues water and results in perverse use that damages the environment, society, and economies, and erodes shareholder value. Failure to do so runs the risk of undermining economic development, diminishing quality of life, and increasing business risk, as well as damaging critical ecosystems.

This report reviews the current situation of valuation and offers a new framework to understand water valuation, risk, and stewardship. Specifically, the report:

SECTION 2: Provides a rationale for why a new valuation framework is needed

SECTION 3: Provides a new water valuation framework

SECTION 4: Uses the new framework to show how to better measure value into the format of traditional financial statements

SECTION 5: Draws on the proposed water valuation framework to put current tools and case studies in context

This report advances the thinking and connections between a number of parallel debates. Based on sound risk and valuation information, it should help to move water stewardship practice along. By connecting water risk to valuation tools and then to stewardship, greater business cases for meaningful stewardship can and will be made once risks are seen in financial terms for business—ones that make the connections between use, actions, failure to act, and opportunities for growth.

2 | WATER VALUATION: VARYING PERSPECTIVES AND THE NEED FOR CLARITY

Water is valued by different groups through different means and metrics. The diversity of perspectives, and the shared aspect of water (*i.e.*, water can be both a public good and a private good), means that the landscape of water valuation can be confusing. The following three perspectives briefly outline the main views on how water is valued and provide the basis for a framework.

2.1 | THE PERSPECTIVE OF BUSINESS: WATER AS A FINANCIAL COST, LIABILITY AND RISK

Overall, business has tended to value water either as a resource input (*i.e.*, the cost to withdraw or consume water as determined by water prices) or as a liability (*i.e.*, the cost to treat pollution or mitigate regulatory fines), with linkages between water risk and water value being largely anecdotal. Indeed, a scan of case studies (see Section 5.2) suggests that business generally perceives water as a cost or as a risk to sales and regulatory compliance.

The concept of water risk has gained considerable traction in recent years, as companies are experiencing detrimental impacts. According to 2014 data from CDP, 53 percent of companies already experience significant financial impacts from water, an increase of 40 percent from data reported in 2011.[1] Detrimental financial costs are a function of manifesting water risks and are wide-ranging in their scope and nature. For example, physical water scarcity can limit development and production or increase prices; water quality impairment can lead to higher costs and lost productivity. Companies have spent money to modify management and technology as new regulations are implemented. Poor public engagement has also resulted in local-to-global reputational impacts on brands. To highlight just a few examples of these incidents, a series of cases are outlined below illustrating how water is already costing businesses (see Annex A.2).

Despite the recent focus on water risks and their potential to affect corporate value, efforts to link water risk and valuation have been noticeably absent, with one notable exception: extreme weather events. From a global annual average of around $50B in the 1980s, average financial costs of extreme weather events (most of which generate water-related impacts) have trended upwards to nearly $200B, with 2011 representing the historical high of over $400B.[2] Increasingly, insurance (and re-insurance) companies are responding to this reality. In 2014, the National Flood Insurance Program (NFIP), which offers government-subsidized policies for households and businesses threatened by floods in the United States, indicated that rates will rise 18 percent a year until it reaches levels that would reflect the actual risk from flooding.[3] Perhaps owing to the fact that accurate water valuation is in the best interest of the insurance (and re-insurance) sector, this one area remains a well-developed element of water valuation within the private sector.

2.2 | THE PERSPECTIVE OF GOVERNMENT: WATER AS A (PRICED) PUBLIC GOOD AND COST TO BE MANAGED

In contrast to business, government tends to value water through pricing signals as both a basic right and a mechanism to attract business (*e.g.*, low prices to provide water for all citizens, ensure agricultural producers are cost-competitive, or attract investment through low-cost energy), while simultaneously using public tax dollars to correct for externalities (*e.g.*, covering the costs of lost crops during droughts, flood damage, water pollution remediation, etc.). In other words, government water resource planning impacts economic productivity.

Governments are slowly realising that economic competitiveness in a water-constrained environment has implications on national water endowments, management of those resources, and their ability to "hedge" for their own supply—through food (virtual water) or bulk supply. The allocation of good-quality water is a matter of optimizing use for social and economic benefits. In this regard, the public sector has wrestled for many years to find the right ways to value water, with efforts largely revolving around water market pricing signals. Governments must reconcile, on the one side, the fundamental human right of its citizens to access to safe and affordable drinking water and adequate sanitation and, on the other side, the need to provide

[1]CDP (2014) Global Water Report. Available online: https://www.cdp.net/en-US/Pages/events/2014/cdp-water-report.aspx.

[2]World Bank (2013) Building Resilience: Integrating Climate and Disaster Risk into Development l. Available online: https://openknowledge.worldbank.org/bitstream/handle/10986/16761/826480WP0v10Bu0130Box37986200OUO090.pdf?sequence=1.

[3]FEMA (2014) Changes to the National Flood Insurance Program – What to Expect. Available online: http://www.fema.gov/media-library-data/1403633987258-7a504b5ba12674c0f36adb67fe103ee7/Changes_to_the_NFIP_What_to_Expect.pdf.

price signals that incentivize sustainable water use and eliminate harmful practices. Adding to the complexity of pricing, food and energy security is also linked to water pricing policies (*i.e.*, water pricing affects food and energy costs).

California provides a strong example of the costs of water on the economy. While making up only 2 percent of the economy, agriculture in California consumes 80 percent of the state's water and a large percentage of its electricity via irrigation. The State Water Project (SWP) which moves water throughout central and southern California, largely for the purposes of irrigation, annually costs approximately $840 million USD to operate, with agricultural users paying only one-sixth what cities do. The SWP, also consumes some 11,500 GWh at a value of roughly $500 million USD. Thus, while California's agricultural sector contributes some $42 billion dollars to the Californian economy, agriculture also costs taxpayers billions of dollars in water and energy subsidies. Thus, a narrow perspective of the value of water is costing the California economy hundreds of millions of dollars per year.

Some governments have also started to see the value of natural capital, also referred to as "green infrastructure," for the ecosystem services it provides. Indeed, **ecosystem services are more relevant to governments than businesses** since not only do governments often control vast tracts of land (*i.e.*, they own the natural capital that provides the ecosystem services), but they also suffer the costs inflicted by externalities when such ecosystem services are impaired. For example, both the United States (Conservation Reserve Program)[4] and China (Green for Grain)[5] offer payment for ecosystem service (PES) schemes for water-related ecosystem services to the tune of $1.6B and $2.9B per year, respectively. There is an increasing recognition of the large costs of inaction in maintaining water-based ecosystem services and, in general, managing water properly at a basin level.

2.3 | THE PERSPECTIVE OF CIVIL SOCIETY: WATER AS A SET OF SOCIAL VALUES

Water clearly provides a significant—but often difficult to monetize—value to society and nature. This is also of relevance to businesses, since local communities and environmental non-governmental organizations (NGOs) in turn affect a company's reputational water risk.

At the core of the challenge around societal water valuation is the fact that monetary, market pricing of water does not reflect the value of water to society. Maintaining low water prices helps to ensure access to water for drinking, sanitation, food and energy, and yet it can also result in inefficient use and poor allocation decisions. Certain societal values, such as health and recreation, can be put into monetary metrics (as noted in Section 2.5, which tie dollars to societal values). Some of these costs, such as the cost of treating a patient with dysentery, or the cost of paying to take a river rafting trip with adequate environmental flows, are reasonably well-suited to being monetized. However, the value of water for spiritual purposes, such as bathing in the Ganges or for the historical preservation of a famous river crossing, is much more difficult to quantify monetarily.

Discussions, methods and tools aimed at evaluating ecosystem benefits, costs and services have been in play for many years. Initially these approaches were designed to bring greater clarity and awareness of the "un-priced" benefits that economies and society derive from natural systems. Over time, there has been greater acceptance of the role that ecosystem services play—as well as further development of practices which bring "natural accounting" into business decision making. Recent years have seen the emergence of not only key reports (*e.g.*, Millennium Ecosystem Assessment, or MEA, and The Economics of the Environment and Biodiversity, or TEEB) but also standardization efforts (*e.g.*, Natural Capital Protocol). The Natural Capital Protocol defines business natural capital accounting as "the process of systematically recording a business' natural capital impacts and dependencies, assets and liabilities in a consistent and comparable way."

It is important to stress that these natural capital valuation initiatives are an important element of fully accounting for water value. Whether right or wrong, natural capital accounting remains focused on how businesses impact others' (monetized social) value more than how natural capital affects shareholder value. There are several reasons for this:

- **Ecosystem services are rarely material in terms of income** (*e.g.*, funds received by businesses from ecosystem service payment schemes), and accordingly, few companies have placed such natural capital assets on their balance sheets.
- The **liabilities stemming from impairment of such freshwater ecosystem services are rarely borne by businesses**, leading to limited engagement by the business community in the space of ecosystem services.

[4]USDA (2015) Conservation Reserve Program. Available online: http://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index Last accessed: July 29, 2015.

[5]Liu, C. and Wu, B. (2010) Grain for Green Programme in China: policy making and implementation? The University of Nottingham, China Policy Institute, Briefing Series, Issue 60. http://www.nottingham.ac.uk/cpi/documents/briefings/briefing-60-reforestation.pdf.

- In many cases, **businesses operate downstream in catchments and are the beneficiaries of upstream ecosystem services**, rather than controlling the large tracts of land that generate ecosystem services, which, in turn, are often publicly controlled.

For the above reasons, despite a pressing need for greater incorporation, natural capital accounting continues to remain of marginal relevance to the business community.

2.4 | CONFUSION IN THE VALUATION TERMINOLOGY LANDSCAPE

Water valuation is an area full of buzz-words, jargon and terminology wherein meanings vary for different audiences. "Value-at-risk," "stranded assets," "water in the economy," and the "true cost of water" are all regularly employed in water stewardship debates, yet have different interpretations depending on the audience. A couple of terms identified below seek to clarify some common misunderstandings (see Annex A.1 for further terminology).

Water Valuation

The World Business Council for Sustainable Development (WBCSD) defines **water valuation** as:

> *"In the strictest sense, water valuation is about assessing the worth of water to different stakeholders under a set of specific circumstances. However, in this Guide (The WBCSD Guide), water valuation is used loosely to mean 'water-related valuation.' This includes determining values, prices and/or costs associated with six categories of water-related values and impacts. These comprise the three main types of water value (*i.e., *off-stream, in-stream and groundwater values), the hydrological service values provided by non-water habitats, non-water impacts associated with water use, and impacts from extreme water-related events."*[6]

Such a definition is informed by, and is tailored for, their business-minded audience and is limited to the categories outlined in the WBCSD report. This report sought to go beyond these categories and provide a framework that outlined water valuation for various audiences. Furthermore, this report puts forth an argument that the value (and the valuation approach) changes with both the spatial scale (from facility to basin), and level of certainty. As such, for the purposes of this report, WBCSD's definition of water valuation has been modified to the following:

> *Water valuation seeks to determine the monetary and non-monetary value of water-related stocks and flows at various spatial scales to different audiences under varying levels of certainty. For businesses specifically, water valuation seeks to determine the monetary value of assets, liabilities, revenues and costs at the facility and corporate levels under varying levels of risk.*

Value-at-Risk

The second phrase worth noting is "**value-at-risk**." There are two interpretations of the value-at-(water) risk term: (1) a colloquial, general reference to value being at risk from water issues (*e.g.*, scarcity affects business operations and, therefore, value), and (2) a specific, finance-based statistical methodology developed to evaluate the chances of losing a certain amount of money over a certain period. This latter, specific methodology, sometimes expressed as VaR (Value-at-Risk), calculates the maximum loss expected (or worst-case scenario) on an investment, over a given time period and given a specified degree of confidence.[7] Therefore, it is important to clarify when discussing "value-at-risk" in the water space as to whether the speaker is referring very generally to the concept, or to the specific statistical methodology.

2.5 | A REVIEW OF EXISTING WATER VALUATION FRAMEWORKS

Water valuation has a long history, and the following review focuses on efforts in recent years to capture water valuation frameworks for business audiences in particular. Most of these efforts have tended to focus on valuation for the purposes of pricing (*i.e.*, setting residential, industrial and agricultural water rates) or the value of water as it relates to ecosystem services via its total economic value. The following is a short review of some key publications.

The World Business Council for Sustainable Development (WBCSD) has led work on water valuation to help clarify this space for business audiences. In 2012 and 2013, WBCSD produced two guides, "Water Valuation: building the business case"[8] and the "Business Guide to Water Valuation"[9]. For the

[6]WBCSD (2013) Business Guide to Water Valuation. Available online: http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15801&NoSearchContextKey=true.

[7]Investopedia (2015) An introduction to Value-at-risk. Available online: http://www.investopedia.com/articles/04/092904.asp

[8]WBCSD (2012) Water Valuation: building the business case. Available online: http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15099&NoSearchContextKey=true.

[9]WBCSD (2013) Business Guide to Water Valuation. Available online: http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15801&NoSearchContextKey=true.

FIGURE 1. **WBCSD Water Valuation Framework**

latter publication, WBCSD established its own water valuation framework (Figure 1). The WBCSD report is intended to help businesses undertake a water valuation exercise and provide guidance on scoping, planning and embedding valuation into business processes across areas of operations, marketing and reporting. It provides an extensive number of case studies with a heavy focus on valuation of water-related ecosystem services. The WBCSD framework outlines five areas in which water affects value, with one of these (enhance decision making) cross-cutting over the other four.

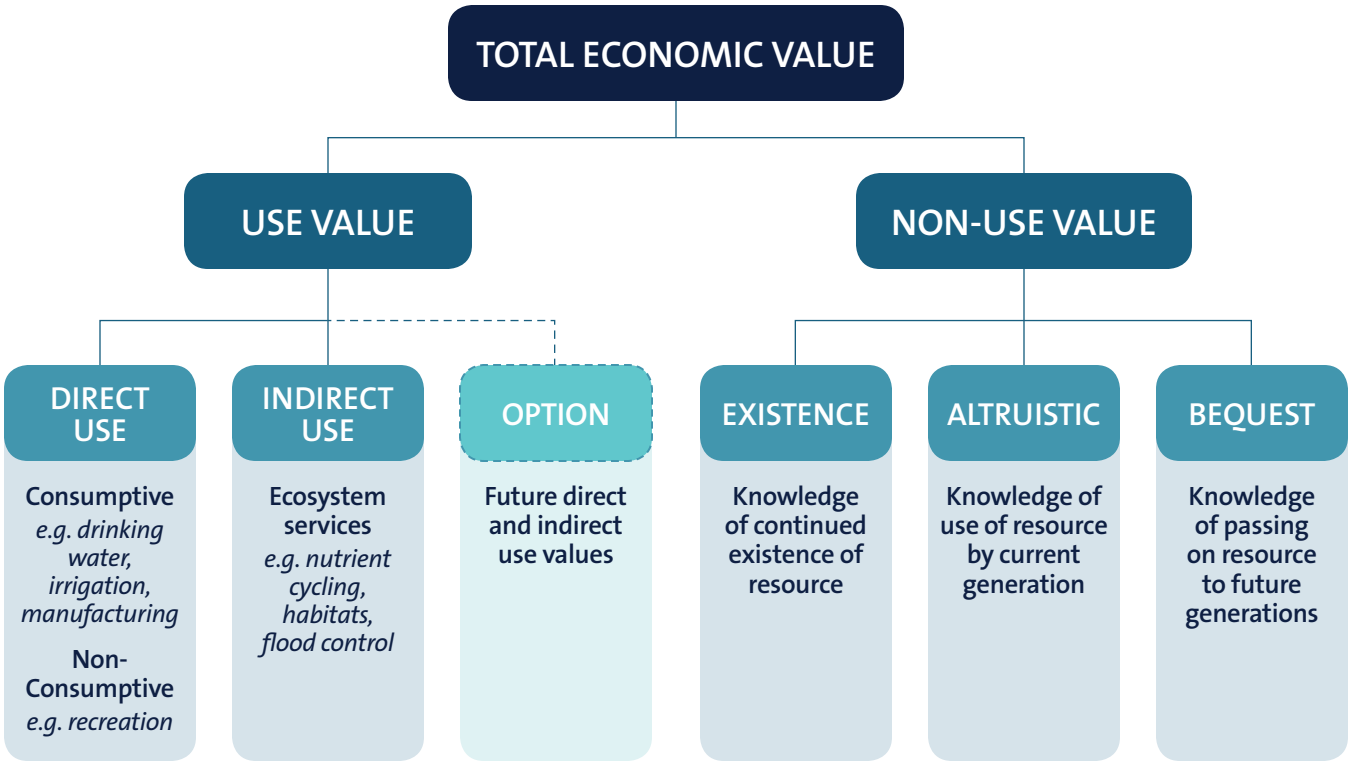
While this framework is a useful categorization of how water affects value within companies, it provides little rationale for the basis of these divisions and tends to focus on select corporate values, while at the same time mixing scales. The WBCSD water valuation framework is presented here in the context of the proposed Water Valuation Framework to contrast the approaches. In contrast to the WBCSD reports, this report is focused on a framework and analysis of efforts. Our specific guidance to companies undertaking water valuation efforts will be addressed through improvements to the IFC Financial Valution Tool and the WWF Water Risk Filter.

Another commonly referenced approach—reflected in both the MEA and TEEB—is the Total Economic Valuation (TEV) framework (Figure 2) referenced in a 2010 publication.[10] The TEV approach adopts a more theoretical and economics-based approach to valuation. It distinguishes between direct use value (which is often reflected in market values, even if only partially reflective of the value of water), and non-use value. TEV also focuses on the use of valuation techniques that convert non-use value into monetary forms through methods such as contingent valuation.

As a theoretical framework, TEV is useful to explore the ways in which something such as water can be valued. However, it usually tends to be inaccessible to business audiences since firms do not receive monetary value from non-use values and rarely account for indirect value, preferring engineered solutions. While option values, especially for water use, are beginning to receive greater attention (*e.g.*, via the value of water allocation trading in market such as Australia), this area is only beginning to penetrate business thinking. Moreover, TEV does not explore the way in which water (or water-related issues) affects shareholder value and is not presented in a format that

[10]WorleyParsons Canada Ltd. and Economics for the Environment Consultancy Ltd (2010) Water Valuation Guidance Document, Canadian Council of Ministers of the Environment PN 1443 ISBN 978-1-896997-92-6 PDF. Available at: http://www.ccme.ca/files/Resources/water/water_valuation_en_1.0.pdf.

FIGURE 2. **Total Economic Value Framework**



business managers can readily adapt. So, while it is a useful framework for government in considering how to set water prices and govern water resources, until such time as companies are compensated for other use and non-use values, TEV is of less use to corporate audiences. For more information on TEV approaches, see Brander et al. (2010).[11]

Both of these frameworks are useful but limited in their scope to water valuation. While the WBCSD framework offers some specifics, the TEV framework is relatively comprehensive. As a result, they both fail to provide business audiences all the specifics needed for decision making. The combination of inadequate frameworks, terminology confusion, and variable perspectives formed the basis for the need for a new water valuation framework. Specifically, the above issues highlight the need for a water valuation framework that:

- distinguishes the different perspectives and approaches to valuation;
- distinguishes current value from future value that is exposed to risks;
- clarifies where different tools, terms, methods, and initiatives fall within this landscape;
- provides a comprehensive approach to capturing all of the various aspects of value that water influences. This is particularly important given the failure of many previous efforts to address the full range of water value;
- informs a clear methodology for business that can better articulate the value of water-related issues, and put this value into financial accounting terms to communicate how water links to assets, liabilities, revenues and expenses; and
- is sufficiently flexible to work not just for business audiences, but also for public sector economic development agencies, as well as those interested in assessing the social and environmental value of water.

[11]Brander, L., Gómez-Baggethun, E., Martín-López, B., and Verma, M. (2010) Chapter 5 The economics of valuing ecosystem services and biodiversity, in The Economics of Ecosystems and Biodiversity: The Ecological and Economic Foundations. Available online: http://www.teebweb.org/wp-content/uploads/2013/04/D0-Chapter-5-The-economics-of-valuing-ecosystem-services-and-biodiversity.pdf.

Outflow from the Jajmau sewage and effluent treatment plant in Kanpur. **CREDIT:** WWF

3 | WATER VALUATION FRAMEWORK

The following water valuation framework links various concepts such as water risk, water stewardship and water value, in an effort to add clarity in this space. By "framework" we mean a visual diagram which can separate, or distinguish, different aspects of valuation to illustrate between approaches, methods, tools, etc. Fundamentally, the valuation framework is based along two axes: certainty and scale of where value manifests. The "certainty" axis looks at the likelihood of water-related value manifesting, while the "scale" axis looks at the spatial distribution of where the water-related value lands.

To break down the framework, the following section is organized into three sub-sections:

- **Section 3.1** discusses different ways of distinguishing the value of water. It explores the horizontal axis and highlights how scale can be used to differentiate between proprietary value versus shared societal value at the basin level.
- **Section 3.2** discusses how risk and uncertainty factor into the value of water. It explores the vertical axis and highlights how the level of certainty of value can distinguish impacts on current financial positions.
- **Section 3.3** seeks to demonstrate how water users—facilities, companies, or governments—can measure and harness value at multiple scales and levels of certainty through water stewardship.

3.1 | NESTED VALUE (X-AXIS)

To walk through the Water Valuation Framework, it is best to begin with the X-axis (horizontal), which differentiates the scale of water value. As one moves from left to right, water-related value goes from proprietary to shared, on the far right. The water-related value of interest to business is generally found on the left-hand side of the axis. Sub-components of this sphere are explored in Section V. Such proprietary water-related value nests within economic value, which in turn, nests within both societal and ecological value. Of note is that facilities tend to have an even greater focus on input prices, production/infrastructure and regulatory costs, and efficiency, while corporate managers need to consider not just facility costs, but other business aspects such as sales revenue impacts and intangibles such as brand value. Goodwill and other intangibles, which sometimes show up on a firm's balance sheet, tend to be further to the right than the cost of inputs to a production facility. In general, valuation along the left side of the spectrum tends to be rooted in financial accounting.

As value expands to the right, there is a tendency to shift between disciplines to inform valuation. The first shift is from finance to economics. Moreover, there is a shift between sub-disciplines within economics: from neo-classical economics to environmental and ecological economics, and ultimately into interdisciplinary areas such as the study of societal well-being. The final shift is from social sciences to the arts (philosophy) and natural sciences (also called ecological integrity, which would be captured under societal benefits/social sciences).

A derivative of Figure 3 (Figure 4) can also help to shed light on commonly used terminology. The first term is the price of water, which is the charge dictated typically through government regulations via a local water service provider such as a public or private sector water utility. Current price is positioned on the framework in the lower left, where price is certain and experienced very much by the facility. Furthermore, water price can be conceptualized both in terms of current price, but also expected future prices, which is signalled by rate increases, as well as longer-term, less-certain prices. Such prices, which remain on the left of the framework, are still felt by the facility, but the level of future water prices shifts the shorter- and longer-term prices vertically up the framework.

The second term is the cost of water, which is the total cost linked to water withdrawals and discharges, as well as other costs. The cost of water is linked to the price of water, but it covers all of the areas where costs are increased due to water use. This includes costs such as tertiary treatment, energy costs to move/heat water, and operational water-related costs. Furthermore, numerous administrative costs can also be affected by water use. These so-called "soft costs" typically increase as water-related challenges increase and, accordingly, should be thought of as water-related costs. These include administration costs, staffing, and costs linked to water: reporting, disclosure, legal, regulatory compliance, engineering, environmental management, to name a few. Lastly, capital expenditures, typically on infrastructure, are part of the cost of water. While flood mitigation engineering or drought tolerance technology may not always be accounted for as a water-cost, failing to manage water risks typically drives up such water-related capital expenditure costs.

FIGURE 3. The value of water to a company, the economy, society and nature

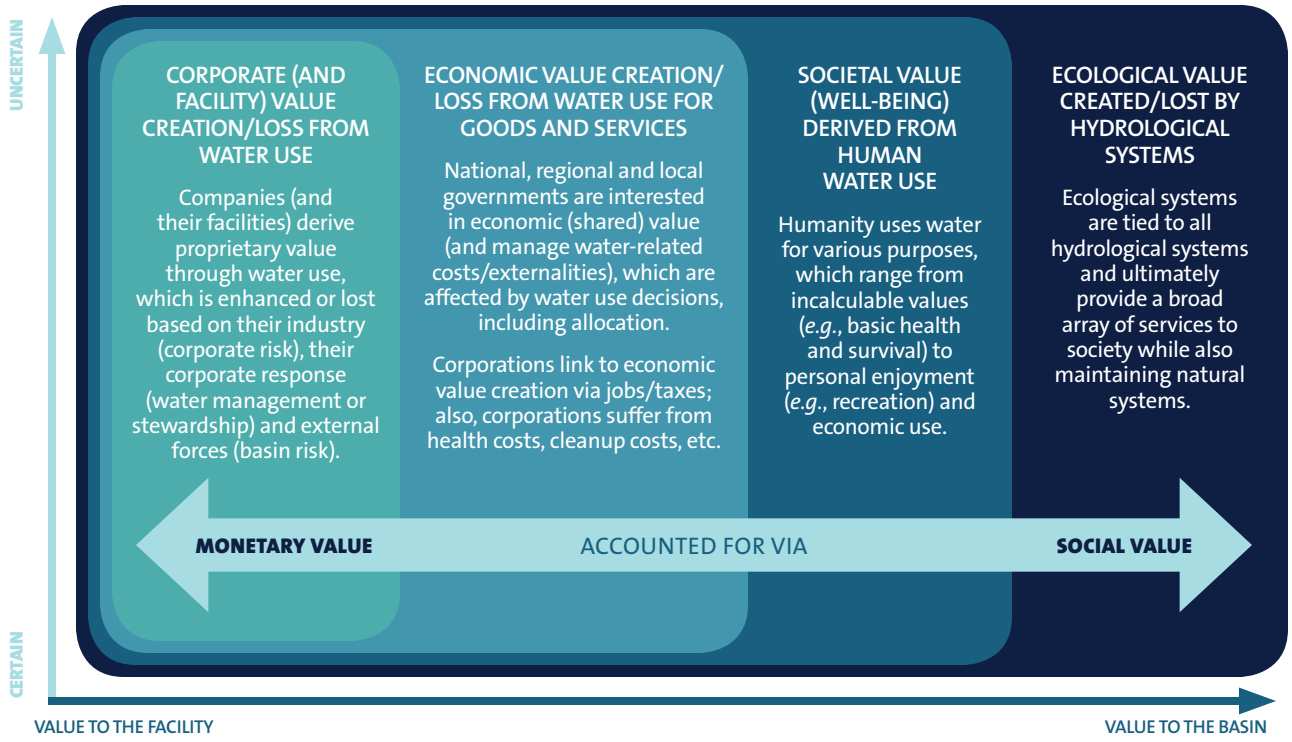
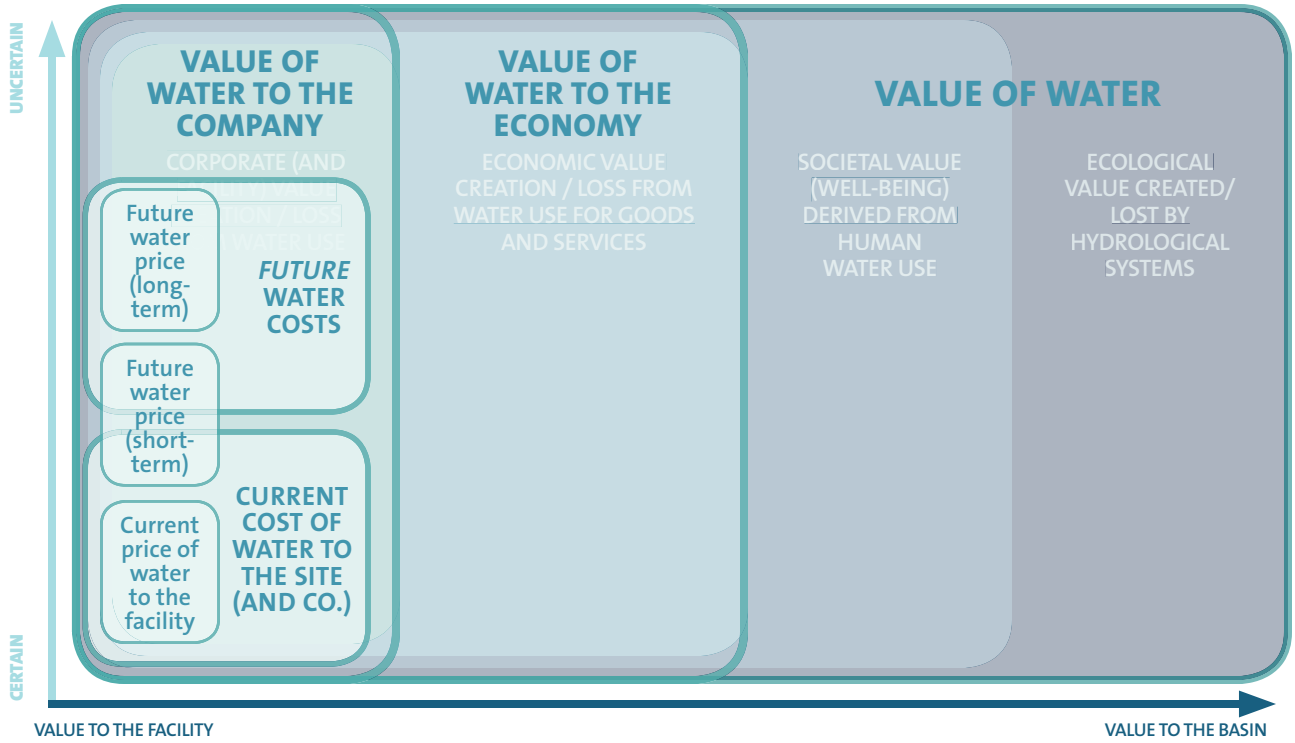


FIGURE 4. Understanding the difference between the price, cost and value of water



It is important to note that water costs are not only certain and proprietary (*i.e.*, located in the lower left) but also broader in scale, extending from the facility to the corporate sphere; and are also exposed to uncertainty and risk (higher on the framework, and further to the right). For example, poor water management may cause a spill which not only involves cleanup costs to the facility, but also may result in brand damage and, therefore, public relations costs for the firm.

Finally, we get to the concept of the value of water, which employs an even more comprehensive view, and for companies it covers costs and revenues. Like price and cost, value includes both present (certain) value as well as future (uncertain) value that may be at risk. Since income and assets are affected even more by corporate and economic actions, the corporate "value of water" is again broader in its sphere (a greater area to the right, and is also exposed to uncertainty and risk).

In addition to corporate value of water, the value of water also changes depending on the scale of the evaluation. The "value of water" to the economy (*i.e.*, water in the economy) captures how water creates both value and "drag" for the economy and would include measures ranging from GDP to the externalities paid for by taxpayers to remediate spills and respond to water-borne diseases.

Lastly, the total value of water, which covers not just value to the company and the economy, but to society and nature as well (*i.e.*, the full horizontal and full vertical axis) covers all of these areas, along with an array of non-monetary measures. This realm sometimes employs more methods of valuation, such as contingent valuation, to shift valuation into the "monetary" economic sphere.

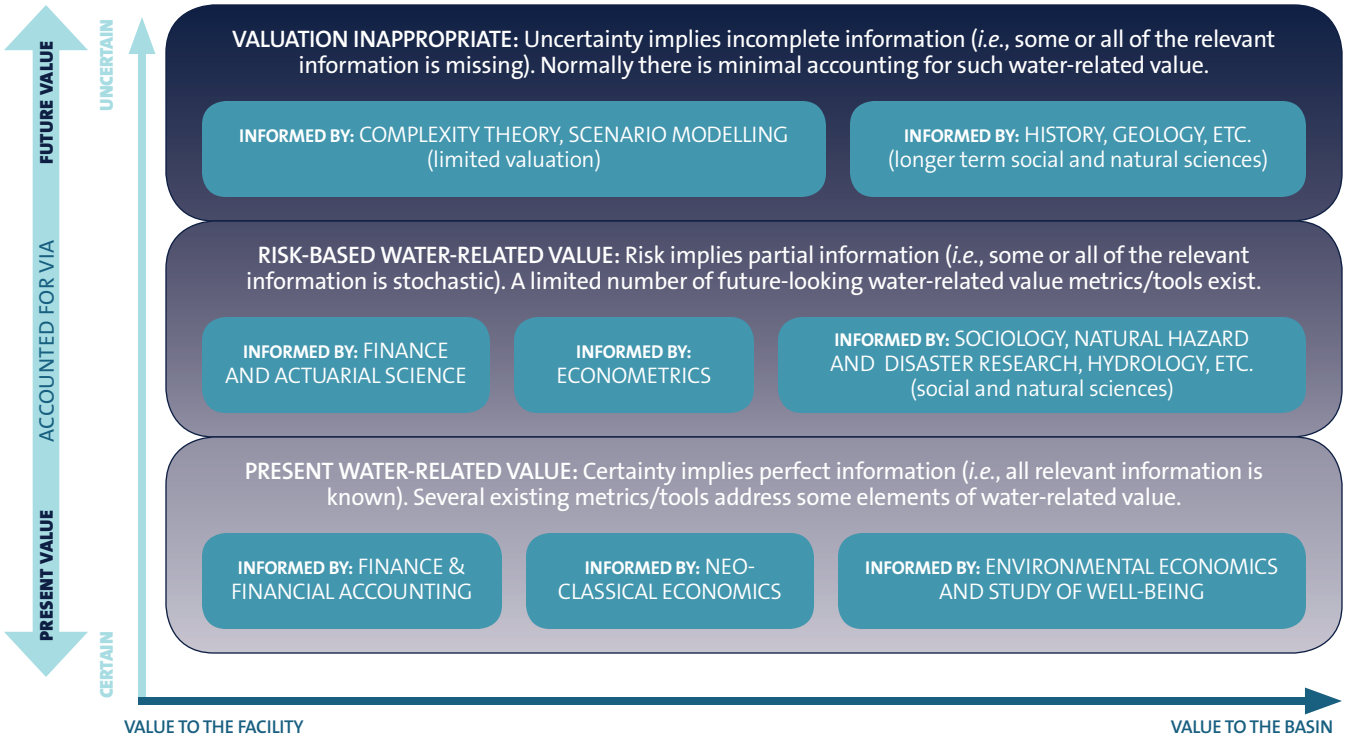
What is critical to emphasize is that the price of water, while being quite well-known (and often quite low), is only a very limited element of value (both on the X-axis and Y-axis). When people think of how much they pay for water and consider that cost as the "value of water," it does the economy, society and nature a disservice by leaving value unrecognized.

The implication of this framing is that *water-related value has a tendency to be linked across scales and is accounted for via different forms of value, with businesses often focusing on a very limited form of monetary value* (i.e., *the price of water).*

3.2 | RISK AND UNCERTAINTY (Y-AXIS)

Shifting from the horizontal to the vertical Y-axis, the framework also separates water-related value along the lines of certainty and risk (Figure 5). While certainty implies perfect information, uncertainty implies incomplete information. In turn, risk implies partial information. Different disciplines have emerged that measure highly likely (*i.e.*, certain) value such as financial accounting, while others measure less certain

FIGURE 5. How valuation is affected by uncertainty



(*i.e.*, risk-based) value, such as actuarial science. As we shift up the Y-axis into the realm of "unknowable" (*i.e.*, complete uncertainty), valuation techniques begin to break down because the error range (*i.e.*, standard deviation) becomes too large to make valuation useful. Thus the greater the level of certainty, the more accurate and the more appropriate valuation techniques become. This is not to say that valuation cannot be useful when exploring high levels of uncertainty, but it should be treated with caution in such circumstances.

When combined with the horizontal and vertical axes, further refinement at the various disciplines within the framework can be made. Companies tend to view water value from the perspective of finance, and, specifically, financial accounting. Similarly, whereas neo-classical economics explores present economic activity through such measures as GDP, econometrics has emerged to explore relationships in part to better understand future-facing trends. Conversely, environmental economics explores how economic policy affects the environment. Governments tend to view water value from the perspective of economics, tracking allocation of water resources via production, consumption, and transfer of value. Lastly, society values water from the perspective of well-being, which explores elements of happiness, while fields such as disaster research and hydrological, and often climate-related modelling, explore how uncertainty may affect future human well-being.

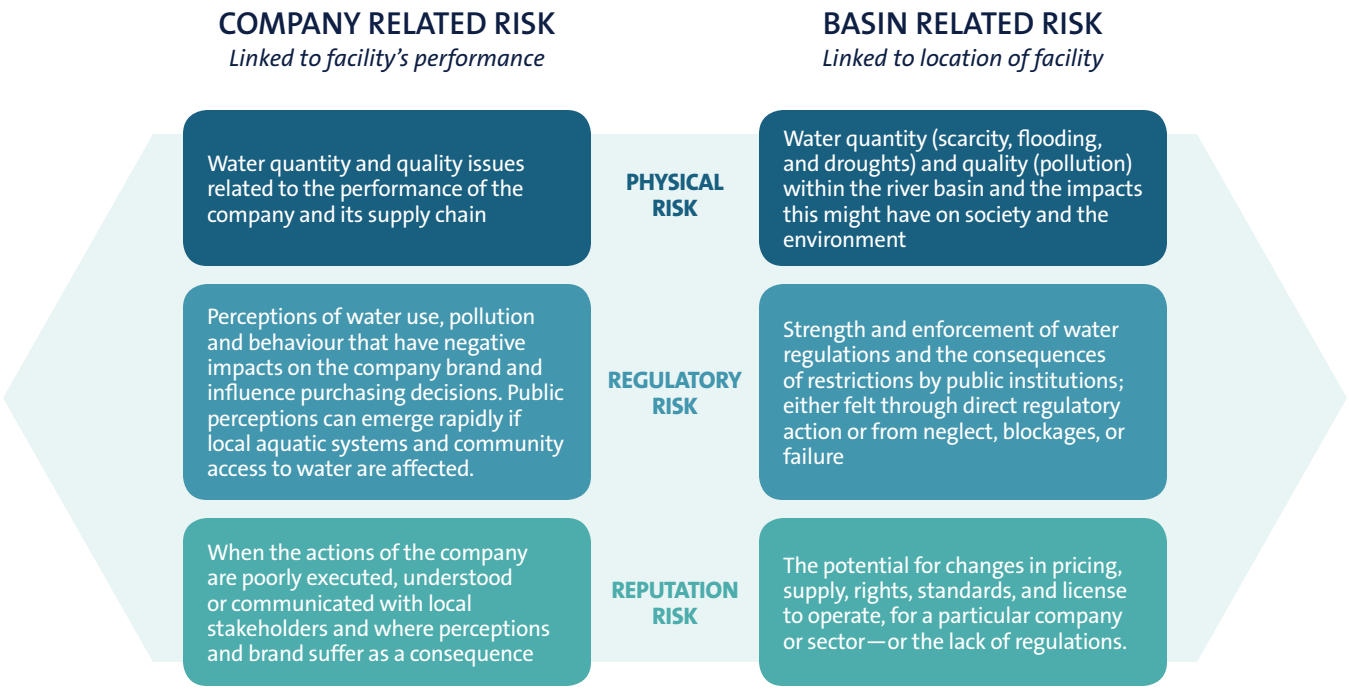
3.3 | PUTTING TOGETHER THE PIECES: RETHINKING WATER MANAGEMENT IN THE FACE OF WATER RISK AND VALUATION

3.3.1. A brief overview of water risk

There has been extensive discussion around the concept that water poses not only reputational risks to companies, but more immediate direct operational risks as well. Water risks exist at a spatial level—such as at a river basin, for example—directly linked to the conditions in that basin. Other risks may relate to specific company profiles and performance. An overview of types of water risk is given in Figure 6.

The typical focus of many companies is to assess basin-related risks, such as scarcity and pollution, and then to mitigate these risks by influencing the company itself. This can be done, for example, through improving water efficiency and water quality. This approach may lower company-related risks, but not necessarily the basin-related risks and will almost always be insufficient to improve business risks driven by external factors. In order to reach a level of greater risk management, a company (or any stakeholder, for that matter) will require that not only should their own house be in order (thereby addressing some of their risks), but that they also engage in the external environment where other basin-related risks are present. In this case, the focus lies in improving and supporting better basin

FIGURE 6. **Types of water risk**



cooperation and dialogue, to engage with key stakeholders and improve the general state of how the river basin is governed. This concept is referred as water stewardship. Almost always, a combination of internal and external action will be required to manage risks.

Physical water risk concerns the direct issues facing any operation because of changes in the flow, quality, or availability of water. Examples include the output reductions brought on by drought and water shortages in the United States, India, Pakistan, and Brazil in 2011, when cotton prices reached an all-time high, prompting companies such as Gap to cut annual profit forecasts by as much as 22 percent.[12] Company engagement with public water policy because of such physical risks includes the food and beverage industry concerned with production and agricultural water requirements, household chemical manufacturers concerned about negative water impacts through their products' use, and financial institutions concerned about investment risk because of unreliable supplies to clients.[13]

Regulatory risk drives businesses to protect their legal licence to operate through compliance with relevant legislation, and to understand and influence policies and regulations that apply to their operations. On the one hand, companies voice the concern that unless they "get their act together" on water at operational, strategic, and advocacy levels, they may face fines, prohibitive laws, loss of water access, and increasingly stringent water regulation. On the other hand, they see the failure of public entities to regulate fairly, enforce laws, and create level playing fields as obstacles to economic growth.[14] There is a wide variation in how companies engage with government over these issues, highlighting not only sectorial differences in water stewardship but also the idea that many industries are favoured by government because of their contribution to the economy.[15] A further issue is the apparent confusion about the nature and direction of regulatory risk, with companies interpreting the lack of effective, vociferous regulatory activity as either a boon or a bane.

Reputational risks affect brand value and market share and are associated with increased visibility of negative impacts on communities and ecosystems because of water use by business.[16] The growth of social media activism—where images can move from field to front page within minutes—has the potential to support much greater public scrutiny of corporate water use. Whether it concerns water use by drink manufacturers and bottled water companies, the impact of East Africa's cut flower industry, or the supply of Peruvian asparagus to UK supermarkets, greater media coverage of water problems has given rise to business concern over reputations and reactions in the market. Reputational impacts have significant, long-term financial implications for a company and do not always need to be accompanied by legal proceedings or material environmental impacts.

These experiences and one-off incidents have not necessarily had the desired effect of moving companies toward a more enlightened and strategic path. Often, and even in the face of significant financial loss, water has remained mainly hidden within companies and failed to gain the necessary attention it deserves. As stated earlier in regard to CDP's 2014 water risk report, while companies state that approximately two-thirds of risks are expected to impact on both direct operations (65 percent) and supply chains (62 percent) now or within the next five years, only 6 percent of companies have targets or goals for community engagement, 4 percent for supply chain, 3 percent for watershed management and 1 percent for transparency. No respondents set concrete targets or goals around public policy.

3.3.2 A brief overview of water stewardship

As companies increasingly recognize the importance of water risks to business fundamentals, the interest in corporate water stewardship has grown. More and more companies are realizing that basin-related water risks (Figure 6) are impossible to rectify through internal action (Figure 6, left) and that internal efficiency is only one part of their response.

While there is still not a general consensus over a formal definition of water stewardship, the Alliance for Water Stewardship (AWS, 2011) defines the concept as: "The use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions. Good water stewards understand their own water use, catchment context and shared risk in terms of water governance, water balance, water quality and important water-related areas; and then engage in meaningful individual and collective actions that benefit people and nature."

[12]Larson, W.M., Freedman, P.L., Passinsky, V., Grubb, E. and Adriaens, P. (2012) 'Mitigating corporate water risk: Financial market tools and supply management', Water Alternatives, vol 5, no 3, pp582–603.

[13]Orr, S. and Cartwright, A. (2010) 'Water scarcity risks: experience of the private sector', in L. Martinez-Cortina, A. Garrido, and E. Lopez-Gunn (eds) Re-thinking Water and Food Security, CRC Press, London.

[14]Porter, M.E. and Kramer, M.R. (2011) "Creating shared value: How to reinvent capitalism—and unleash a wave of innovation and growth", Harvard Business Review, January-February, pp62–77.

[15]Pegram, G., Orr, S. and Williams, C. (2009) Investigating Shared Risk in Water: Corporate Engagement with the Public Policy Process, WWF-UK, Surrey, UK.

[16]Ibid.

WWF defines water stewardship for business as a "*progression of increased improvement of water use and a reduction in the water-related impacts of internal and value chain operations. More importantly, it is a commitment to the sustainable management of shared water resources in the public interest through collective action with other businesses, governments, NGOs and communities.*"

There has been a large movement, mainly through the UN Global Compact's CEO Water Mandate, to bring clarity and guidance to water stewardship through reports and guidelines around collective action, accounting, terminology and public policy. AWS also formed to fill a gap in market certification and capacity building on water stewardship, while organisations like WWF now have well-established programmes seeking to leverage this business risk into substantive collective action at river-basin level.

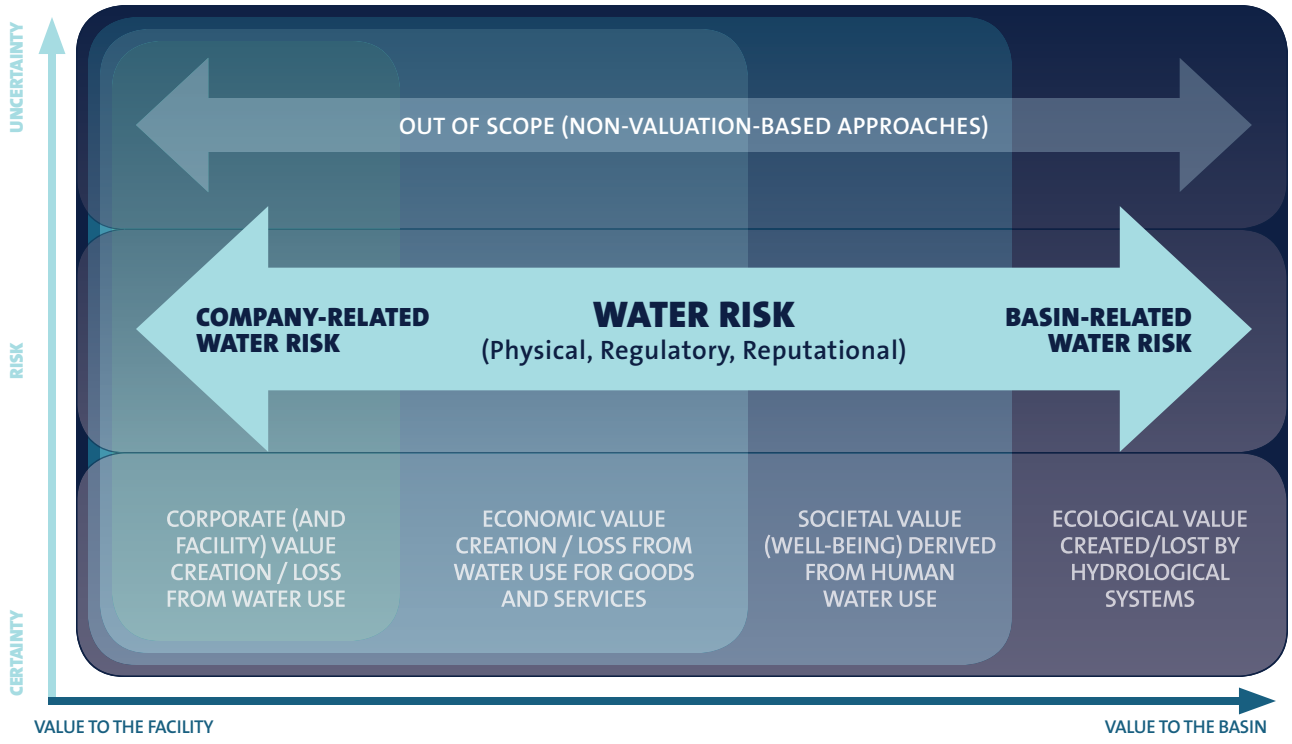
There are questions from traditional water resource management on how water stewardship as a new paradigm is distinct from Integrated Water Resource Management (IWRM) and its foundational principles of equity, sustainability, and efficiency. The answer is that water stewardship embodies "taking care of something which one doesn't own" or "of looking after an asset or resource on behalf of others." At its core, water stewardship is differentiated because of whom it infers is contributing to water resource management and taking action on behalf of other users. If IWRM is considered as actions by an authority mandated by the state to manage water resources on behalf of all water users, then water stewardship can be considered as actions by water users themselves to contribute to the management of the shared resource towards public-good outcomes. Water stewardship is, therefore, about non-traditional, private actors increasingly involving themselves in the management of the common pool—public good regarding water. As a progression from IWRM, with its emphasis on participation, this shift can arguably be considered a success.[17]

As company attitudes and learning matured, there has been a shift from simple product LCA (life cycle assessments) to company water footprints, to impact studies and, most recently, to water risk analysis. Now with the emergence of a water valuation focus, there is a need to illustrate how these pieces fit together.

3.3.3 Revisiting water risk and stewardship through the Water Valuation Framework

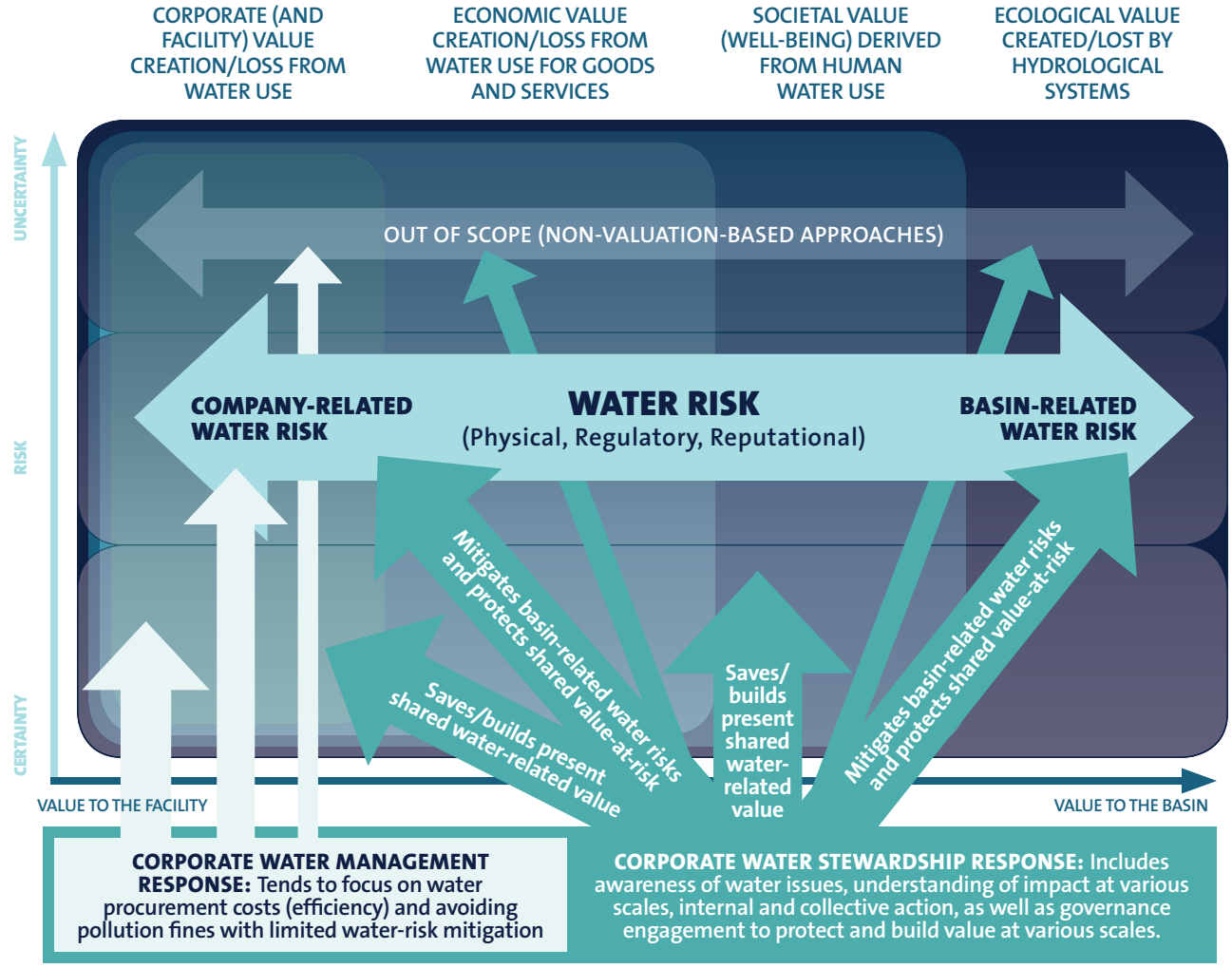
With a general overview of water risk and water stewardship, these concepts can be placed in the context of the water valuation framework. Figure 7 then places water risk (from Figure 6) into this framework.

FIGURE 7. Exploring how water stewardship preserves value at multiple scales



[17]Corporate Water Stewardship - New paradigms in private sector water engagement. Nicholas Hepworth and Stuart Orr (2013) In, B.A. Lankford, K. Bakker, M. Zeitoun and D Conway (Eds) "Water security: Principles, perspectives and practices". In Press, Earthscan Publications, London.

FIGURE 8. **Overlaying corporate management and stewardship**



As seen in Figure 6, Figure 7 also illustrates water risk with the left-side boxes representing company-related water risk (and on the far left, facility-related water risk), while across the right side are the basin-related water risks linked to economic, social and environmental water value. Accordingly, addressing company-related water risks provides greater proprietary water-related value, while addressing the basin-related water risks not only delivers proprietary value (via risk mitigation), but also creates economic, societal and ecological water value. In other words, engaging in basin-level risk response provides benefits at multiple scales.

From here, the difference between traditional corporate water management and corporate water stewardship can be made.

Traditional facility-level water management approaches (as noted in light blue on the left) tend to focus on efficiency and pollution prevention within the facility. Such forms of water management largely emphasize the present price and costs of water with some focus on water risks stemming from potential on-site incidents such as spills. In other words, it places an emphasis lower on the Y-axis, and to the left on the X-axis (Figure 8). Such water management approaches tend to have less emphasis on risk, and specifically little, if any, emphasis on basin-related risk. Relying solely on such water management approaches means that facilities remain at risk from the uncertainty that stems from issues that originate from economic, social and ecological forces at play within and often beyond the catchment; *i.e.*, to the top and right on the framework. Thus, water management is a passive form addressing uncertainty by limiting costs from disasters through on-site actions; *i.e.*, value preservation at the facility scale.

Conversely, a water stewardship approach complements best water management practices using collective action and

governance engagement to take action at the basin level. Stewardship starts to mitigate the uncertainty deriving from basin water risks and preserve water-related value at multiple scales. In working with others, water stewardship asks companies to consider the right side of the X-axis to understand how others value water and how that may impact on them. Water stewardship helps to preserve and create value at various scales—at the facility, corporate, economic, social and ecological levels—thus enabling a firm to demonstrate how it adds value to the community, the economy, and society. Companies are increasingly willing to reduce water risks through external actions once they understand better financial implications and the connections.

Water stewardship also more actively and comprehensively assesses all levels of risks deriving from various scales found on the Y-axis. Even at high levels of uncertainty, where valuation is not well-suited, water stewardship offers a better understanding of highly unknowable situations through increased dialogue with others that provides insights to potential scenarios.

What is important to note is that all of these elements are interrelated. A poor corporate response such as a weak water management response, focused only on improving efficiency, will not change the water context, nor address risks. Therefore, while a limited management response may increase some value in the short term at the facility scale, it will result in the loss of value at other scales which could ultimately affect value at the facility as well. Conversely, water stewardship can address water value more comprehensively.

3.4 | CONCLUSIONS ON THE WATER VALUATION FRAMEWORK

The previous three sections provided an outline of how water-related value varies both in terms of scales and certainty. They also explored the concepts of price, cost, and value, as well as water risk and its linkages to water management and water stewardship.

The framework highlights several key issues, including:

1. Water is valued differently by different stakeholders (see Figure 3). Furthermore, corporate water value is nested within economic, social and ecological water value. It is also critical to distinguish between the price, cost and value of water, since a focus on the former two (especially price) results in significant undervaluation of water in corporate decision making.
2. Water valuation is linked to uncertainty (*i.e.*, water risk), which manifests at various scales and is informed by different disciplines using different audience-specific methodologies. Both time and space are linked to water value (see Figure 4). To effectively communicate water value, it is key to understand which fields (*e.g.*, finance, economics, etc.) are relevant given your audience.
3. Water stewardship is a form of water risk mitigation that seeks to preserve and create value at multiple scales and levels of certainty. Conversely, as seen in Figure 8, a more traditional, limited water management response focuses on a narrow range of current facility and corporate value elements (largely, present cost), only partly addresses corporate water risks, and largely ignores basin-level risk mitigation or value creation. Unlike traditional water management, water stewardship helps to maximize long-term shareholder value as well as social value. Companies are therefore encouraged to push their response efforts, via water stewardship, to the right and top of the valuation framework to maximize water value.

Wegala Community Water Supply and Sanitation Project. Sri Lanka. **CREDIT:** Simone D. McCourtie / World Bank

4 | COMPREHENSIVE METRICS TO UNDERSTAND HOW WATER AFFECTS SHAREHOLDER VALUE

With the general framework in place, one can shift from conceptualizing different forms of water value to providing a tangible set of water valuation metrics. In other words, this section explores how managers can comprehensively measure water-related value to better capture shareholder value and better articulate the value of water to other audiences such as shareholders, communities, and government regulators. Recognizing the ubiquity and importance of the balance sheet and income statement in the corporate landscape, specific metrics have been aligned with these two commonly employed accounting formats. Figures 10 and 12 are a spin on the water valuation framework through these respective financial accounting lenses.

The water valuation framework from Section 3 provides the foundation for providing corporate managers with specific metrics. First, current/"certain" value can be separated from future/"at risk" value. Second, different types of metrics will be more or less relevant at different scales. For example, some metrics will be more material to a facility, while others are more material to corporate headquarters. These general concepts, along with some framing borrowed from financial accounting, underline the approach employed to distinguish and outline specific water valuation metrics. However, it is recognized that the specific location of the metric categories is subjective.

It is also worth noting that the horizontal X-axis has been compressed in these figures. In an effort to focus on the most material water valuation elements for corporate audiences, there is a bias towards measuring the water value that companies currently experience, with less emphasis on the social and ecological value that a company affects. This emphasis reflects the pattern of financial statements as a whole, and means that the measures focus on current, proprietary value for businesses, and do not fully address future risk-based value, nor do they fully capture the value at larger scales (*i.e.*, economic, societal and ecosystem value). The primary emphasis is on the material issues for business, and just as financial statements are accompanied by a narrative in annual reports, such water-adjusted statements would need to be accompanied by both a water risk disclosure and a narrative covering water stewardship actions to provide shareholders a complete picture.

The intention is to provide a set of water-related metrics, structured around traditional financial statements, to enable businesses to understand how their shareholder value is being affected by water.

4.1 | ACCOUNTING FOR HOW WATER AFFECTS PRESENT VALUE: REVISITING FINANCIAL STATEMENTS

4.1.1 A Water Valuation Balance Sheet

To structure the metrics around traditional financial statements, it is helpful to begin by understanding a generic balance sheet (Figure 9). It outlines a number of broad categories (*e.g.*, assets, liabilities, etc.) of which many are affected by water. While some categories are not water-specific (*e.g.*, cash has no water parallel), many of the categories listed in a balance sheet are either affected by water or have a water parallel. For example, supplies may be water supplies; pre-paid insurance may relate to water-based insurance; building and equipment may also both be water-specific. Other categories may likewise be affected by water issues.

Similarly, water can affect liabilities as well as shareholder equity, though since shareholder equity is affected through the change in asset and liability value, it is omitted from Figure 10.

Taking the general categories found in a balance sheet (Figure 9), water-specific versions can be placed onto the water valuation framework to establish Figure 10.

FIGURE 9. A traditional balance sheet example

ASSETS	LIABILITIES
Current Assets • Cash • Accounts receivable • Investments • Inventory • Supplies • Prepaid insurance	**Current Liabilities** • Accounts payable • Wages payable • Interest payable • Taxes payable • Warranty liability • Other accrued liabilities • Unearned revenue
Capital Assets • Land & property • Use rights • Buildings • Equipment	**Long-term liabilities** • Notes payable • Bonds payable
Intangibles • Goodwill • Trade names • Patents / IP	**Shareholder Equity** • Common stock • Retained earnings

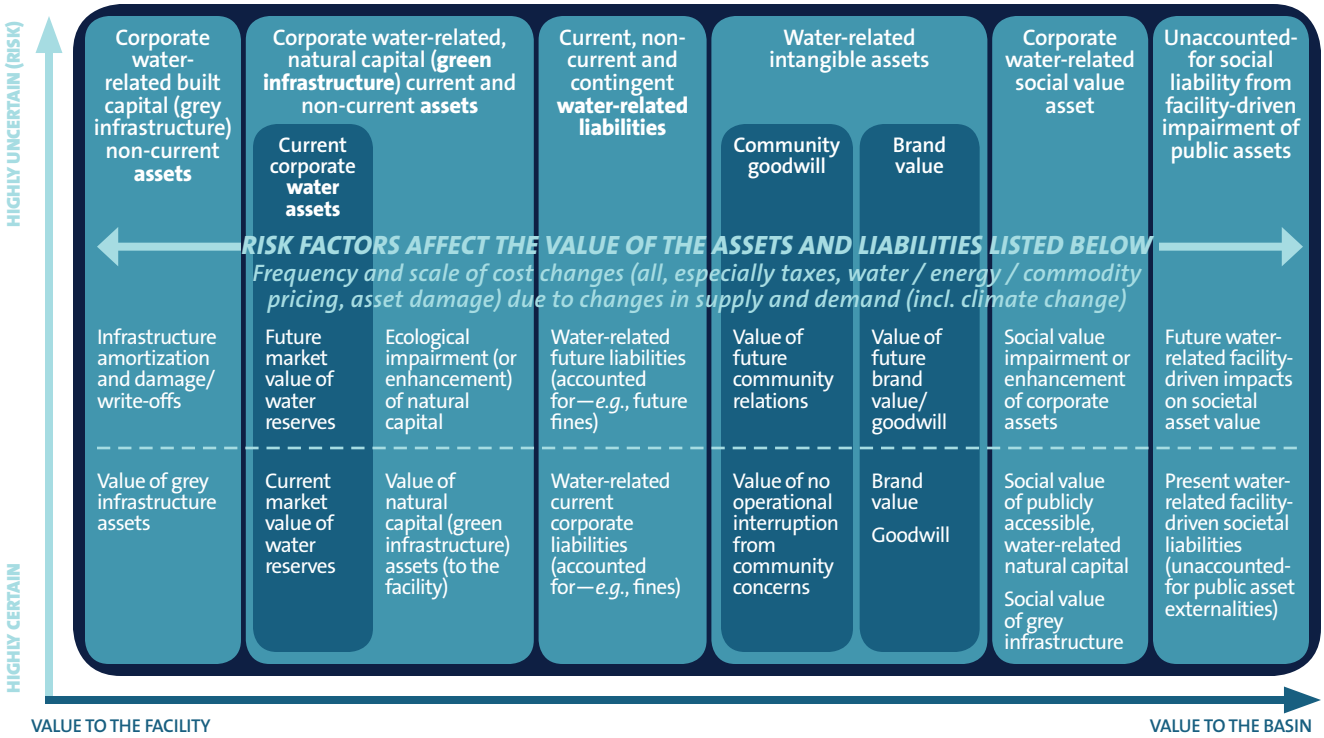
Like the broader valuation framework, Figure 10 contains a vertical Y-axis, which goes from more certain "current" assets and liabilities to less certain "non-current" assets and contingent liabilities (*i.e.*, those that are more affected by risk). The dotted line represents a somewhat arbitrary split between present and future aspects, recognizing that changes in water (due to physical, regulatory or reputational forces) will affect changes in supply and demand that, in turn, modify the value of assets and liabilities. As an example, an extreme flooding event could decrease value through destroying infrastructure, or a drought event could increase value through the value of groundwater reserves being worth more due to scarcity. Similarly, perceived abundance (real or not) may decrease value, thus highlighting the importance of monitoring baselines and stakeholder communication. Basin context factors, water risks, and corporate response may also affect water-related assets and contingent liabilities.

Along the horizontal axis in Figure 10, various categories of water-related assets and liabilities are listed and generally arranged in order of importance from the facility-level (left side) to the corporate level (central/right) to the societal level (right side). Note that the majority of the elements listed in Figure 10 will be of relevance to the facility. Whereas the facility is often concerned with on-site infrastructure, local water levels and community relations, the corporation is very concerned about the brand and social impact liabilities. Hence, public relations tend to land in the corporate sphere.

BOX 1. Climate change and water value

Extreme weather events are increasingly meriting adaptation actions, including both efforts designed to buffer against impacts (*i.e.*, resistance measures), as well as efforts designed to rebound from impacts (*i.e.*, resilience measures). Traditional responses to limit catastrophic loss have focused on grey infrastructure (*e.g.*, storm water retention ponds, water towers, etc.), but increasingly are recognizing the role of green infrastructure (*e.g.*, riparian vegetation, wetlands, etc.) in limiting losses. In addition to infrastructure, management actions, staffing and even regulatory engagement actions, which carry expenses, need to be considered as investments relative to potential losses. Thus, adaptation expenses are a preventative measure not only to preserve asset value and limit liability, but also to ensure that when such extreme weather circumstances arise, operations may continue unabated, thereby maintaining revenues and to ensure that assets do not become stranded. With improved water valuation, managers are better able to make decisions about investments into climate change adaptation.

FIGURE 10. A balance sheet perspective of water valuation



This general interest of water value assets and liabilities dictated the positions of the categories from left to right. These include grey infrastructure (far left), which is typically of great importance to the facility, to physical water assets (*e.g.*, groundwater reserves or on-property lakes, etc.), to green infrastructure, to intangible assets such as goodwill and brand value. Liabilities, which affect the corporation, are next covering both current and contingent liabilities that may manifest from water-related issues that arise, such as an outstanding regulatory fine. Lastly, on the far right is the provision of social value by proprietary corporate assets, followed by the effects of the company on the social value of social assets.

Whose assets provide value to whom?

Water-related assets may be both corporate (*i.e.*, proprietary) and public. Similarly, the value such assets generate may be received by society or by the company. Into this mix, companies may affect not only the assets they control (*i.e.*, corporate assets), but also may affect public water-related assets (*e.g.*, water use may affect the function of a downstream wetland). Simply put, there is the need to distinguish between whose value is being affected (*i.e.*, the company's or society's), as well as whose asset is providing such value (*i.e.*, the company's assets or public assets). These combinations are illustrated in Figure 11.

The proposed water value balance sheet and income statements account for the combinations illustrated in Figure 11 through various means. Both social value and the basin-related risks posed to elements in financial statements (*i.e.*, assets, liabilities, revenues and expenses) are typically poorly handled through traditional financial accounting methods. Only the current/non-current/contingent liabilities (top left) and the proprietary built and natural capital assets, O&M costs and revenue impacts (bottom right) are generally captured in financial statements. The often natural, capital-related externalized social costs (top left), various contextual risk factors (top right), and social value provision (bottom left) are ignored, or at best included as footnotes.

This distinction is an important one in the context of natural capital in particular since the asset value (and the provision of services covered in section 4.1.2) often differs between the company and society. At present, companies often receive value from publicly owned natural capital assets, but rarely own large areas of proprietary natural capital assets. The only exceptions are extensive land-use industries, such as forestry and agriculture. Thus, at present, there is minimal incentive to account for natural capital since corporate natural capital (often minimal) generates minimal monetary value, and the social value impacts driven by corporate mismanagement are externalized. While companies are affected by (or are dependent upon) public natural capital, such assets are difficult to account for except through value-at-risk modelling exercises. Indeed, in general, financial statements are better suited to accounting for value with greater certainty (*i.e.*, below the dotted line in Figure 10), despite ongoing efforts (see Box 2) financial statements are currently still not adequately suited to handle value-at-risk or strategic opportunities other than through narratives.

FIGURE 11. Capital asset value provision and receipt

		WHO RECEIVES THE VALUE FROM THE CAPITAL ASSET	
		SOCIETY (SOCIAL VALUE)	**COMPANY (PROPRIETARY VALUE)**
WHO CONTROLS THE CAPITAL ASSET	**PUBLIC WATER-RELATED ASSET**	Company *can affect* a public asset providing social value (a corporate-related reputational and regulatory water risk). Accounted for in balance sheet and income statement: (1) as **current, non-current and contingent liabilities** (*i.e.*, accounted for—*e.g.*, fines); (2) as an **externalized social liability** (*i.e.*, currently unaccounted for—*e.g.*, cumulative water quality impacts on social assets); (3) as a **risk factor affecting community goodwill and brand value**; as well as (4) an unaccounted for, water-related **societal cost**; and (5) indirectly as a risk factor affecting revenue impacts	Company can *be affected* by public asset providing them proprietary value (a basin-related physical water risk). Accounted for in balance sheet and income statement: (1) as a **risk factor affecting asset value** in balance sheet or (2) as a **risk factor affecting costs** in income statement
	CORPORATE WATER-RELATED ASSET	A company can manage a corporate asset to provide social value. Accounted for in balance sheet and income statement: (1) as a **corporate social value asset** (also likely to affect value of **community goodwill**); (2) the value of **social benefits** from corporate water use	A company can manage a corporate asset to provide proprietary value. Accounted for in balance sheet and income statement: (1) as a **corporate asset (proprietary built capital asset and natural capital asset)**; (2) **operations and maintenance costs**; (3) **revenue impacts**

BOX 2. Improving sustainability accounting—Sustainability Accounting Standards Board (SASB) and the Natural Capital Protocol (NCP)

Recent years have seen the emergence of another key effort to improve how sustainability issues, including water, are accounted for in financial assessments. Two of these efforts, Sustainability Accounting Standards Board (SASB) and the Natural Capital Protocol (NCP), merit note.

In 2014, SASB released its preliminary accounting standards which seek "to develop and disseminate sustainability accounting standards that help public corporations disclose material, decision-useful information to investors." Notably for the purposes of this report, SASB provides a set of standardized metrics on water, which is an important step for benchmarking. However, *SASB does not seek to convert such water metrics into water value metrics,* but instead leaves them in their "native format." For example, SASB standardizes water measurements in the semiconductor manufacturing sector by having users measure the "Total water withdrawn, percentage recycled, percentage in regions with High or Extremely High Baseline Water Stress." Conversely, SASB does not convert this withdrawal into its financial implications, but leaves this interpretation to Environmental, Social and Governance (ESG) analysts and others to undertake.

Similarly, in 2015, NCP released its preliminary natural capital principles and framework document that outlines 10 steps across four stages (frame, scope, measure/value, and apply). While much of the focus is external (how companies impact, or are dependent upon, others' natural capital), this initiative holds the promise to provide a rigorous, standardized method that will enable natural capital accounting for companies and provides an important piece of the larger puzzle on water valuation.

The categories outlined in Figure 10 can then be reorganized into a modified, water-specific balance sheet (Table 1) which provides a comprehensive set of metrics that enable a business to understand how water affects its present-value balance sheet. Companies are encouraged to draw from Table 1 to select the most material metrics for their operations. Furthermore, understanding water risk can help to inform which metrics are most material. For example, companies facing high reputational water risk should look to metrics that measure intangible value. What is important is that companies move beyond only considering pumps and filters, and begin to employ a more comprehensive approach in understanding how water affects value across a range of assets and liabilities. Failing to comprehensively understand how water affects a firm's balance sheet will likely lead to poor management decisions and a loss of shareholder value. Measuring such present water value issues will also set the stage for running risk-based calculations (as noted under 4.2).

4.1.2 A Water Valuation Income Statement

The same issues of neglected water-related value come up from an income statement perspective. Figure 12 provides a traditional income statement as an illustration and, again, we can begin to link water to elements outlined in a traditional income statement.

FIGURE 12. A traditional income statement example

REVENUE	EXPENSES
Goods and services	Employees
Revenue from government	Administration expenses
Sales of assets	Cost of goods sold
Other revenues	Depreciation and amortization
	Write-down and impairment of assets
	Finance costs
	Net loss from disposal of assets
	Taxes
	One-time expenses
	Other expenses

Like the balance sheet, various elements of the income statement are affected by water-related issues. Sales can be affected by water-related NGO campaigns, the cost of goods sold (COGS) increases when drought affects commodity prices, and, similarly, expenses are affected by water pollution, and so forth.

Accordingly, we can allocate various costs along with revenues allocated along the horizontal axis, while the same sort of present and future division occurs along the vertical axis.

As in Figure 10, the left side of Figure 13 is biased towards greater concern to the facility (*i.e.*, operations/maintenance and administration) while the right side of the figure is biased towards responsibilities typically held by corporate functions (*e.g.*, financing and revenue) since responsibility for such matters typically lie with those respective units. This is valuable to bear in mind when speaking to site management or corporate staff, but, for the most part, the distinctions are not that important. Provision of flows of social value are also denoted on the far right of Figure 13.

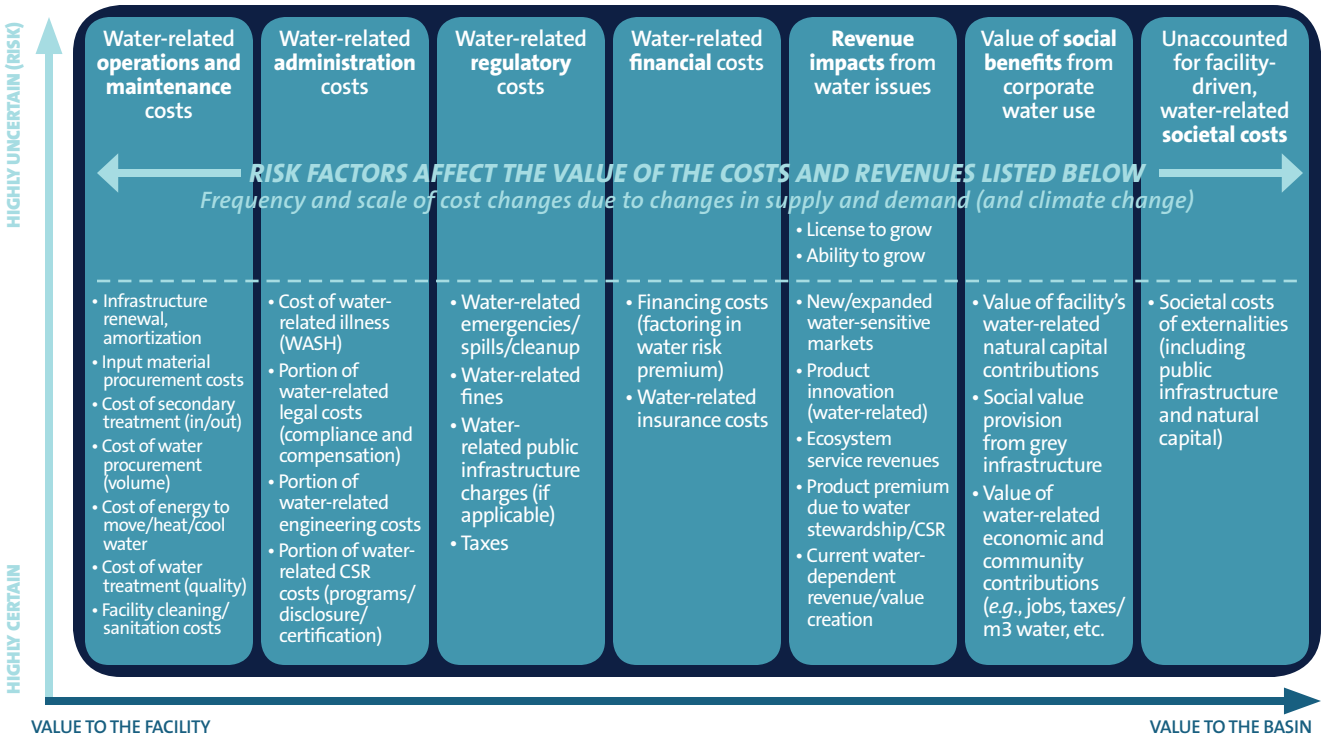
What is more important to note is which aspects are traditionally accounted for and those that are not accounted for. *Traditionally, water-related costs tend to be limited to the cost of acquiring, treating and discharging water,* which falls under operations and maintenance costs. However, *in calculating the full value of water*

TABLE 1. **A balance sheet for businesses to calculate present water-related value**

ASSETS	CALCULATION	EXAMPLE
CURRENT ASSETS		
Market value of water supply inventory (a specific form of on-site natural capital asset) ***NOTE: covers only the value of the asset to the facility***	Market price X estimated on-site volume	500,000,000L of groundwater at $0.001/L = $50,000
Prepaid weather-related insurance	Dollars spent on weather-related insurance	$25,000 paid for flood insurance; $5,000 paid into federal drought insurance program
Water **use rights**	Opportunity cost of not selling water use rights (value of water if traded)	$20,000 if 75,000,000L of water were traded with another user
CAPITAL ASSETS		
On-site water-related grey infrastructure (built capital assets) **(purification, pipes, pumps, cooling, heating, washing, storm water retention, flood mitigation, etc.)**	Book value or replacement cost of purification equipment	$10,000 for Reverse Osmosis system; $20,000 for pumps; $50,000 for cooling towers, etc.
Proprietary water-related grey infrastructure (built capital assets) **used by the community or other stakeholders**	Contingent (or market) social value provision	Community provided with sanitation facilities worth $50,000
On-site water-related, non-current green infrastructure (natural capital assets) ***NOTE: covers only the value of the asset to the facility***	Replacement cost	$50,000 to replace wetland filtration function with a built purification system to meet discharge requirements
Proprietary water-related, non-current green infrastructure (natural capital assets) **used by the community or other stakeholders** ***NOTE: covers only the value of the asset to stakeholders (not the facility).***	Contingent (or market) social value provision	Land cover preservation enables a recreational salmon fishery worth $250,000 per year.
Water-related chemical **inventory**	Procurement cost of materials	$8,000 spent on ozone; $15,000 spent on chlorine; etc.
INTANGIBLES		
Water-related goodwill **(% of brand value/goodwill affected by water)**	Change in market valuation due to water-related event	Stock value dropped by $1.24/share after company was found guilty of polluting a stream (total value loss = $1.24M)
Water-related patents/IP	Estimated sales value of patent/IP	Proprietary water filtration membrane technology worth an estimated $200,000

LIABILITIES	CALCULATION	EXAMPLE
CURRENT LIABILITIES		
Water-related regulatory fines owing	Total value of outstanding water-related fine	$250,000 fine from regulatory pollution permit violation
Water-related losses from lawsuits outstanding	Total value of outstanding legal/ settlement costs	$1M settlement for phosphoric acid leak into local stream
Water-related taxes payable	Total taxes due X % of funds spent on water-related matters OR water-related fees/levies	$1,000,000 due in taxes (with 2% going to water & liquid waste management) = $20,000
LONG-TERM LIABILITIES		
Long-term water-related liabilities **(*e.g.*, loans, debentures, deferred tax liabilities, deferred water payments, etc.)**	Total financial obligation outstanding (and not due within the year) related to water.	A $500,000 loan taken out to finance water infrastructure
Water (green) **bonds payable**	The face amount, paramount, or maturity amount of bonds issued by a company for water-related matters that are outstanding	A $500,000 bond issued to finance a new water purification operation.
UNACCOUNTED-FOR LIABILITIES		
Water-related **impacts on social assets** currently unaccounted for	Social asset value X proportional contribution to decrease in value	A wetland providing $1M in social value dries up 25%, half of which is caused by the facility's water use = $125,000 unaccounted-for liability

FIGURE 13. **An income statement perspective of water valuation**



to a facility, other costs including administrative (largely, staffing), regulatory (e.g., *fines, taxes, and subsidies), financial expenses* (i.e., *cost of capital) as well as water-related revenues, should be factored into decision making.* For example, as water scarcity increases, a facility not only potentially needs to pay more for water (*i.e.*, water price may go up), but will also often face higher energy prices, need to hire additional staff to address stakeholder concerns, provide greater water information (disclosure), may face additional risk-adjusted financing costs, and be under greater scrutiny from regulatory enforcement agencies. Therefore, when making decisions about addressing water scarcity challenges, all of these additional costs, as well as potential impacts on revenues, should be factored into the financial decision, and just the increased price of water (which is often zero or negligible).

Similarly, as noted above in 4.1.1, social costs are currently often externalized, while social benefits are similarly unaccounted for.

It is worth explicitly noting several aspects above the dotted line in Figure 13. In particular, the concepts of "ability to grow" and "license to grow" are largely future, risk-based concepts, but

TABLE 2. **An income statement for businesses to calculate present water-related value**

SALES AND REVENUES	CALCULATION	EXAMPLE
Gross operating income (*i.e.*, total revenue or value of goods produced to assess operational interruption)	Total revenue (or value creation) per day X number of days of interruption	$4,000,000/252 = $15873/day X 5 days of interruption = $79,365
Other income (*e.g.*, ecosystem service revenues)	Total income received from water-related ecosystem services	$2,000 per month provided from Water Funds for riparian management practices = $24,000
Product premium charged via water-related CSR	(Net revenue of product with water-related CSR brand premium—gross revenue of comparable product without premium) X total sales	$3.50 (for CSR-related bottled water) - $1.00 (non-CSR-related bottled water) = $2.50 X 10,000 units = $25,000
Value of additional sales secured through water-risk-response specific RFPs	Value of sales	$1.5M contract secured due to CSR practices (including water)
Sales of water-related assets	Book value of water-related asset	5 water pumps sold for $2,000 each = $10,000
Government water-related subsidies	Funds provided by government for water-related issues	500,000 m3 traded at $2.00/m3 = $1M

Table 2 continued on next page

Table 2 continued from previous page

EXPENSES AND COST OF GOODS SOLD	CALCULATION	EXAMPLE
COMMODITY INPUT PURCHASE COSTS (COST OF GOODS SOLD)		
Cost of water withdrawal	Increase/decrease in costs due to water-related supply shifts	Almond prices increase by 50% to $12/lb due to drought X 10,000 lbs = $60,000 in added costs
Cost of water treatment (incoming and outgoing)	Total charge from water utility (N/A if using on-site water)	$50,000 for provision of 5ML of potable water
Cost of water-related energy	Total charge from water utility (N/A if no treatment required)	$40,000 for treatment of 4ML of discharged water
Water infrastructure amortization	Cost of energy X % of energy used for moving/changing temperature of water	$1M total energy costs X 33% for water purposes = $333,333
Water infrastructure operations and maintenance costs	Amortization costs for all water-related infrastructure	Water pipes book value = $200,000 amortized over 40 years = $5,000/yr
General selling, general and administrative expenses	Servicing and maintenance costs for water-related infrastructure	$10,000/yr to reverse osmosis system
Water-related staffing costs (engineering, management, legal, admin, CSR, PR)	Water-related regulatory fees	$5,000 water compliance filing fee
Water risk premium for financing costs	Staff salary costs X % of time allocated to water-related matters	15 full-time equivalent staff focused on water at an average of $50,000/yr = $750,000
Water/weather-related insurance costs	Interest rate increase over normal water risk conditions X total loan	0.5% rate increase due to water risk on a 5 year, $1M loan at 4.0% = $13700 extra
Write-down or impairment of water-related assets	Total insurance cost from weather insurance provider	$10,000/yr in flood protection insurance
Losses from water-related asset sales	Total value of write-down	$500,000 write-off of supplies due to flooding
Other one-time water-related expenses	Value of water-related asset sale	5 water pumps sold for $2,000 each = $10,000
Taxes	Total cost	$200,000 for installing a drought-resistant landscape (xeriscaping)
	Total taxes contributed X % of funds spent on water-related matters OR water-related fees/levies	$1,000,000 in taxes (with 2% going to water & liquid waste management) = $20,000
COST OF WATER-RELATED LOST PERSON DAYS		
Outsourced water-use (*e.g.*, laundry, facility cleaning, etc.)	Average daily cost per employee X # of days lost due to water-related illness	300 lost person days due to dysentery @ $300/day = $90,000
Water-related regulatory fines	Total cost charged by outsourcing provider	$50,000/year for cleaning services of facility
Water-related losses from lawsuits	Total fine amount	$10,000 for improper filing of water-related regulatory compliance forms
	Total lawsuit amount	$50,000 due to community water conflict
UNACCOUNTED FOR WATER-RELATED SOCIAL BENEFITS		
Water-related ecosystem restoration and public service provision	Total value gained through provision of services	A company restores an on-site wetland providing $50,000 in social value (water purification)
Water-related volunteering efforts	Number of staff hours X average employee wage for water-related volunteering	20 staff volunteering 8 hours to clean up a creek (with an avg. wage of $20/hr) = $3,200
Giving to water-related non-profits	Amount donated	$100,000 to WWF for freshwater conservation = $100,000
Water-related tax contribution	Total taxes contributed X % of funds spent on water-related matters OR water-related fees/levies	$1,000,000 in taxes (with 2% going to water & liquid waste management) = $20,000
Water-related employee salaries contributed to the local economy	Total staff salaries for water-related staff	7 water-related staff at $50,000/staff person = $350,000
Unaccounted for water-related social costs (see Natural Capital Protocol for more details on methods to calculate natural capital related costs)	Total value lost through impacts to public infrastructure and natural capital services	A wetland providing $1M in social value dries up 25%, half of which is caused by the facility's water use = $125,000 cost

are sufficiently important to cash flow that they merit special attention. Increasingly, as demand exceeds renewable water supplies, we are seeing water scarcity affect cash flows as well. While water rights and allocation mechanisms vary considerably across the globe, physical water scarcity increasingly has the potential to affect a facility's ability to grow or license to grow. These two distinctions are made to reflect the fact that while water availability affects ability to grow, water accessibility affects license to grow. Without ability or license to grow, a facility's future revenues may be limited, which also threatens to result in a stranded asset and affect the asset's value.

Table 2 now takes the income statement elements outlined in Figure 13 and reformats them into a tabular form with specific calculations and examples to assist companies to shift the thinking from the water valuation framework over to their existing financial statements.

Similar to the concept of affecting social assets and providing social value from proprietary corporate assets (noted in 4.1.1), some companies are also interested in demonstrating the financial value of certain important societal contributions or social costs (see Box 3), *i.e.*, social and ecological value creation/preservation. For example, in 2012, Caesars Entertainment worked with VeraWorks to estimate the monetized social value of their efforts to support the local community and contribute to the local economy.[18] Accordingly, while not all companies currently track such social value contributions or loss, there is a growing movement to at least understand the impact on social value.

In summary, water touches many aspects of both the balance sheet and the income statement but very few of these are seen in corporate annual reports. Rather they are ignored, attributed to other factors, or presented in a very limited fashion. The result is that corporate and facility-level decision making makes non-optimal decisions with regards to water, and in turn, causes shareholders to lose value.

4.2 | ACCOUNTING FOR (FUTURE) WATER-RELATED VALUE-AT-RISK AND AT LARGER SCALES

As noted above, financial statements are stronger in presenting current (or future, but known) value and not as good at capturing uncertain value, nor value at larger societal and ecological scales. Accordingly, the water-related balance sheet and income statement presented in 4.2 does not comprehensively cover the risk-based value elements very well.

BOX 3. Environmental Profit and Loss: Kering's efforts to integrate sustainability into financial statements

One of the most prominent efforts relating to valuation and financial statements is the work undertaken by Kering (and notably under their brand Puma) and PriceWaterhouseCoopers, to account for environmental externalities and natural capital. In their own words, The Environmental Profit & Loss (E P&L) is "a new way of estimating the cost to society of the changes in the environment as a result of our business activities and those as a whole of our supply chain...While these costs are not currently borne by business, we believe as a responsible business that we should minimize our negative impact on natural capital and find ways to enhance and support natural capital."

While this is an important step forward in valuing traditionally ignored assets, for the purposes of this report, what is important to flag here is that Kering is accounting for *others' value,* not its own corporate value. Put differently, Kering's efforts focus on calculating value on the right side of the valuation framework, while largely ignoring the left.

Source: Kering (2015) http://www.kering.com/sites/default/files/document/kering_epl_methodology_and_2013_group_results_0.pdf

To account for this value (*i.e.*, water-related value-at-risk), the simplest solution is to begin to tie probabilities to the metrics in 4.1 and 4.2. To do this, there are several possible approaches.

One such concept is Value-at-Risk (VaR). Further to VaR, a number of modelling techniques, such as Monte Carlo simulations, can be used to explore different estimated probabilities. This latter approach is the basis for IFC's FV Tool, which is designed to assess the cost-benefits of how various sustainability interventions might mitigate risks and therefore preserve value. While both of these techniques are sufficiently flexible to handle most forms of future water value that may be susceptible to water risks, it is also worth explicitly flagging the strategic aspects to future water risks—most notably how to address future ability/license to grow. To illustrate this concept, it is easiest to use an example.

The efforts in recent years on mapping and modelling water risks have brought basin-related water risk to the forefront of many companies' minds. However, given that companies have minimal impact over water use at the basin level, and yet their future assets/worth and ability to grow/future revenues are

[18]Sustainable Brands (2015) The New Financial Metrics of Sustainable Business: A Practical Catalog of 20+ Trailblazing Case Studies. Available online: http://e.sustainablebrands.com/resources-report-new-financial-metrics-of-sustainable-business.html?_ga=1.101492994.2066379976.1435852502.

BOX 4. The case of Sasol—linking water risk, valuation and investment

As companies have begun to understand water risk, they have considered how their investments can maximize not only corporate benefits, but also contribute value at other scales.

For example, Sasol, a global integrated energy and chemicals company, recognized that due to water-stressed basin conditions, water security was becoming a material challenge to its operations in the South African Vaal River system. Sasol uses about 4 percent of the catchment yield; municipalities use approximately another 30 percent, losses from which can be as high as 45 percent due to the aging infrastructure.

Sasol approached municipalities to implement water conservation initiatives that would make a substantially greater contribution to improving water security than what would have been realized by focussing only on enhancing water management in its internal operations. By investing in the municipality as opposed to their plant, Sasol obtained higher water saving rates, accrued the benefits they were seeking in water supply, and contributed to the wider community's water supply through improved municipal works—all at a fraction of the cost of using internal technology implementations alone.

This case illustrates how an understanding of contextual water risk leads to a broader stewardship response that can improve value creation for multiple stakeholders, all the while delivering risk mitigation and greater shareholder value for the company.

BOX 5. A shadow price for water?

One other approach not explicitly discussed here, but emerging with some companies (*e.g.*, Nestlé) is the idea of establishing a shadow price for water. This approach, which is a long-standing concept applied where there is future uncertainty around price, has been extensively used for carbon in recent years. Furthermore, the emergence of some tools (*e.g.*, the Water Risk Monetizer) provide an estimated future water price extrapolated off of various risk trends.

While such an approach does have a place and can help to address not only future price changes but also account for liabilities, shadow pricing is still limited in that it accounts for water, but not water-related value. For example, it would fail to capture the increase in salary costs or energy costs via increased water use. Shadow pricing also reinforces the emphasis on water's price, which leads to a narrow focus and ultimately risks poor management decisions. Accordingly, while noting it here, we have opted for shadow pricing to remain outside of the valuation framework and recommended approaches contained in Section 4.

likely to be impacted by basin-related water stress (scarcity/pollution), many companies have begun to explore how they can strategically invest in the basin to mitigate basin-related water risks and preserve future water-related value (see Box 4). For example, investment in drip irrigation may improve field-level efficiency, but collective groundwater use may ultimately result in everyone's wells running dry, and therefore jeopardizing the investment in the drip irrigation infrastructure.

Other approaches to incorporate risk also exist, including shadow pricing (see Box 5), as well as approaches to assess specific issues, such as assessing corporate dependencies on water-related natural capital (see Natural Capital Protocol framework[19]). However, many such approaches are limited to one aspect of the water valuation framework. Ongoing efforts will be required to improve how water risk is accounted for in financial statements.

Finally, while Section 4.1 covered several corporate-related elements relating to economic, social and ecological value contributions or losses (see Figures 10 and 13), it is important to note that much of the water-related value at these levels needs to be accounted for through entirely different means and by different and non-corporate audiences: *i.e.,* government. Therefore, while beyond the scope of this report, public sector agencies are also encouraged to explore social accounting methods to measure and manage water-related value at broader scales.

In summary, water-related value, once conceptualized through the proposed water valuation framework, can be represented in the form of financial statements. Traditional financial accounting formats tend to emphasize present, proprietary value, but, increasingly, we are seeing interest and promising efforts to account for social value, and better accounting for water risk in balance sheet and income statements.

[19]Natural Capital Coalition (2015) Natural Capital Protocol Framework—Draft 26 June 2015. Available online: http://www.naturalcapitalcoalition.org/js/plugins/filemanager/files/NCC_Natural_Capital_Protocol_Principles_and_Framework_brochure.pdf Accessed: July 22, 2015.

Women fetch water from the artesian well. The village was settled about 100 years ago. There are over 120 traditional wells that villagers have used to try to get water from over the years. The PPAF funded artesian well has greatly improved the quality of life in the village. Pakistan. **CREDIT:** Caroline Suzman / World Bank

5 | EXPLORING WATER TOOLS AND CASE STUDIES USING THE WATER VALUATION FRAMEWORK

In recent years, various tools and case studies have also begun to emerge that seek to value water. This section of the report will explore some of the more commonly referenced corporate water tools in use, as well as an array of water value-related case studies in the context of the water valuation framework.

5.1 | WATER VALUATION TOOLS

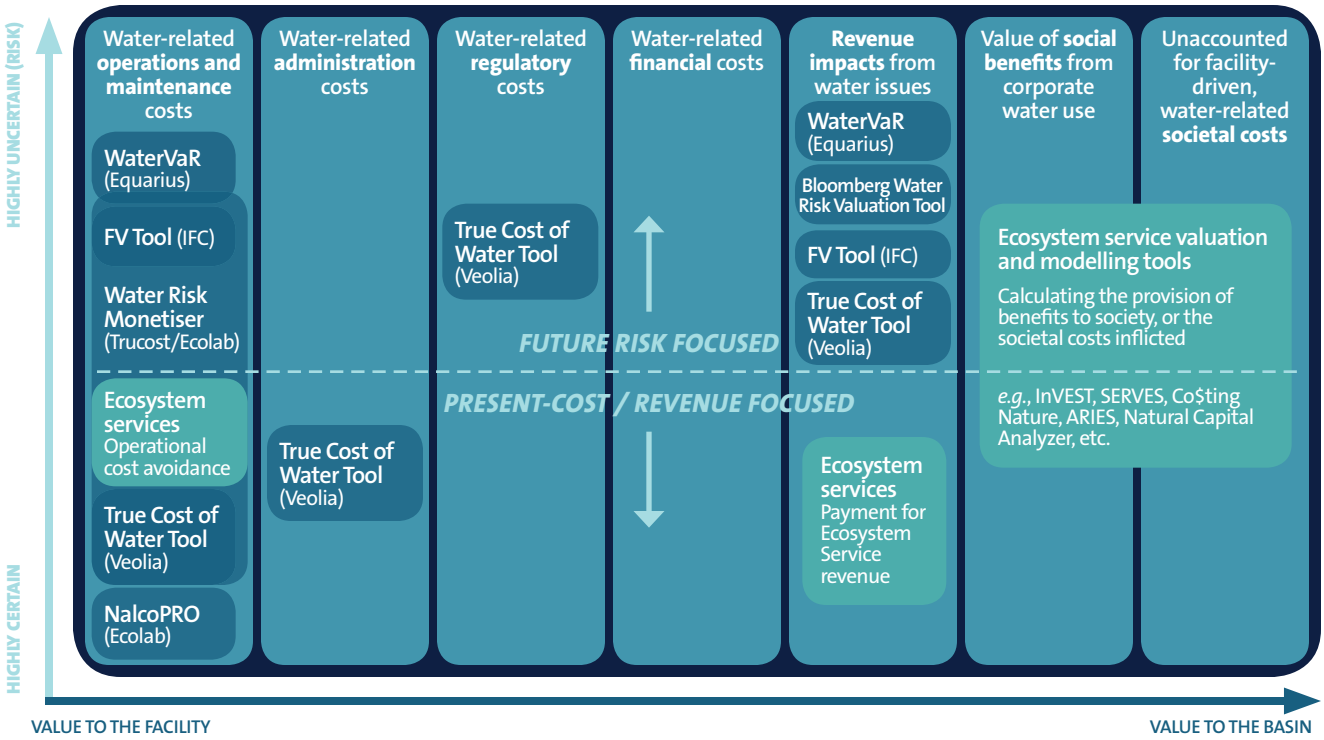
The various water valuation tools available at present have emerged from a variety of disciplines; some from the non-profit world, informed by environmental economics (*e.g.*, Natural Capital Project's InVEST), while others have come from the for-profit world and have been informed by finance (*e.g.*, Risk Analytics' WaterVaR). To date, however, no single tool has managed to comprehensively touch upon all of the areas of water-related value. To illustrate, we can place several of these tools into the income statement adapted version of the water valuation framework (Figure 14).

The majority of these tools have tended to focus on calculating the operational and maintenance costs of water, with a strong emphasis on the price of water to the facility. Nevertheless, some have taken a broader perspective on water-related issues, most notably Veolia's True Cost of Water tool.

Indeed, several tools have emerged seeking to explicitly link water risk to water valuation. For example, Equarius Risk Analytics have developed a WaterVaR tool that seeks to explore value-at-risk through a water lens. Such tools have tended to focus on cash flows as well as operational cost savings. Few have touched upon other areas such as water-related administrative costs, regulatory costs, or financial costs. The latter may be minimal at present as financial institutions are only just beginning to factor water risk exposure into premiums. Insurance and re-insurance providers are already offering forms of insurance against physical water risks at a considerable premium.

It is also worth noting the realm of ecosystem service valuation tools since these are increasingly being discussed in the context of "water valuation" (see Figure 14). The key conclusion that can be drawn from Figure 14 is that there is no single method

FIGURE 14. Placing water valuation tools into the (income statement) water valuation framework



BOX 6. A note on valuation methods

Methods and tools sometimes are confused, but the former merit a note, especially to the finance community who tend to employ a range of methods to account for value. Current valuation methods are firmly focused on assessing value using a mix of the current income statement and balance sheet (*i.e.*, bottom left of the framework). Since water-related value is, at present, poorly reflected through such statements, any sort of derivative analysis (*e.g.*, price-to-book ratio, return on equity, working capital ratios, etc.) is likely to provide an incomplete picture of the value of water to the company.

There are also a number of methods that are more future-facing, including net present value, discounted cash flow analysis, and value-at-risk. Water-specific versions of such methods, such as calculating the present value of future water-related savings, or cash flows from water assets, are other approaches that can be (and are being) employed to value water-related decisions. Finally, some groups have suggested developing water-specific value-at-risk calculations to better modify beta risk values and provide shareholders with a better sense of potential losses from water challenges.

In summary, many valuation methods can, in theory, be applied to value water. Whether or not this becomes a more common practice going forward remains to be seen.

or tool that fully addresses all forms of water-related value for businesses. Rather, there are various tools that cover different parts of the spectrum. This is important to note since the implication is that, at present, businesses are inadequately equipped to factor in the value linked to water and therefore are not easily able to maximize shareholder value.

5.1.1 Water risk tools and methodologies

With the strong focus to date on water risk assessment tools, it is worth briefly touching upon a review of these tools and how they link or do not link to water valuation. Furthermore, much like the discussion around "value," there is some confusion around what is meant when we use the term "risk." Many tools on the market today are, in fact, mapping tools, overlaying company facilities on indicator maps. Others are footprint tools that position themselves around notions of risk. These do, however, have the desired effect and have been—as simple as they are—useful to convey water issues to companies.

Most water risk assessment tools use a weighted average score of several risk indicators to arrive at an indication of risk, and there are no interdependencies between the indicators. This makes the mathematics simpler and more transparent, but disregards the inter-linkages between, for example, a given company's role as a big water consumer and the water scarcity level of the river on its site location.

Therefore, when looking at overall risk scores one will typically see an exposure to a medium level of risk, as the high and low risks are averaged out, especially when lots of different indicators are taken into account. WWF is working on a solution by identifying "critical" indicators. Once the company scores a very high risk level for any of these critical indicators, it will score very high overall.

Currently available water risk tools are not returning the "value" that is at risk. Rather, they tend to return a spatially explicit snapshot of areas whose water conditions are likely to increase risk to an actor operating in that location. While it is a relatively simple solution to combine financial information to the risk scores per assessed site to achieve an understanding of the value of production volumes at risk, this would provide only a very limited perspective in how risk affects value. Such an approach would not constitute a formal Value-at-Risk (VaR) approach (*e.g.*, Equarius Risk Analytics WaterVaR), but would give greater insight into production value exposed to different risk profiles and begin to link water risk with water valuation.

Returning the water risk tool discussion to the water valuation framework, we can place such tools onto the framework (Figure 15), with the recognition that they are NOT assessing water value (with the exception of WaterVAR).[20]

The key takeaway from Figure 15 is that the various water tools in common use are a mix of water risk tools, water assessment tools, and water stewardship tools. There are some water valuation tools, but these tend to be very limited in scope and, in effect, there is no tool available yet for businesses to value water comprehensively.

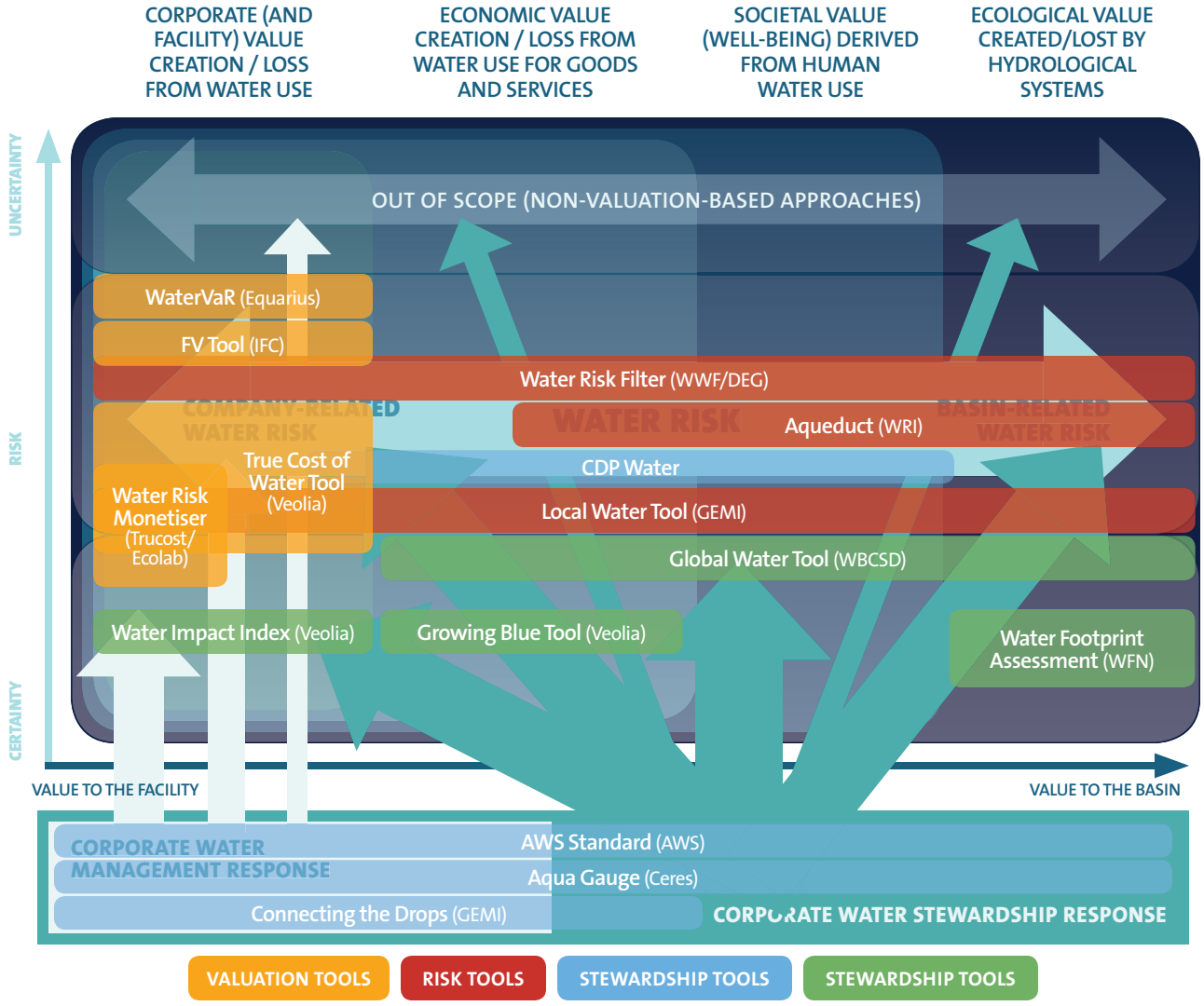
5.2 | WATER VALUATION CASE STUDIES

It is also very informative to assess an array of case studies in the context of the water valuation framework. These case studies were pulled together from a search for corporate efforts documenting value creation/loss due to water-related issues. In total, 34 case studies were chosen (Annex A.2) to highlight a variety of ways in which companies are recognizing how water affects shareholder value.

Taking these case studies and placing them into the context of the water valuation framework (Table 3) allows the corporate actions to be separated by category according to income

[20]For an overview of various water risk assessment tools, please see Annex A.3.

FIGURE 15. **Water tools placed into the water valuation framework**



statement and balance sheet. This sort of categorization provides us with a series of insights.

- The frequency distribution is telling in that we can see businesses are focused on a very limited number of areas of water value. Specifically, they tend to address water issues where it affects the following:
  - Operations & Maintenance (O&M) costs (over 50% were focused here)
  - Limits or prevents regulatory costs (~25%)
  - Revenue (increase/decrease in sales to water-sensitive markets) (~25%)
  - Intangible (brand) assets (~21%)
- The actions taken by businesses in the case studies are also telling in that they provide insight on how businesses seek to preserve/build water-related value:
  - Nearly 50% of the case studies pursued solutions involving building grey infrastructure assets and/or improving operational efficiency.
  - Several companies have engaged in the development of new products or targeting new markets, illustrating how water issues can be not only a cost, but can also drive revenues.

Once again we see the trend of focusing on a combination of water price, limited (largely O&M or regulatory) water costs, and solutions that focus on grey infrastructure. Simply put, the evidence from the case studies suggests that there is a strong need for more comprehensive approaches to assess how water affects shareholder value.

TABLE 3. Water valuation case studies

CASE STUDY	INCOME STATEMENT ELEMENTS						BALANCE SHEET ELEMENTS					
	Lowering operations and maintenance cost	Lowering administrative (incl. legal) costs	Mitigate risk of regulatory costs	Water-related financial costs	Revenue impacts (Increase/decrease in sales to water-sensitive markets)	Revenue impacts (Water-related product innovation)	Revenue impacts (Ability to operate/future ability to grow)	Built water-related infrastructure assets	Development of water reserve assets	Development of water-related natural capital assets	Mitigate risk of intangible asset depreciation	Value of current and contingent water-related liabilities
The Coca Cola Company, Kerala, India (2004)		1	1				1	1			1	
Cameron Bridge Distillery (2005)					1			1			1	
Mariani Packing Company Vacaville, CA (2006)	1		1					1				
The Coca Cola Company, Ann Arbor, MI (2006)					1						1	
Duro Textiles Massachusetts (2007)		1	1									
Southern Company (2008)	1								1			
Colgate Palmolive Morristown, NJ (2009)	1											
Starbucks Coffee Company (2009)	1							1			1	
Kraft Foods, Jacksonville, FL (2009)	1							1				
Finlays Tea (2009)	1		1									
Nestle, South Africa (2009)	1			1				1				
Cisco Systems (2010)	1											
Ford Motor Company, Chihuahua City (2010)	1							1				
Hennes & Mauritz AB/H&M (2010)	1										1	
Kimberly-Clark Kluang, Malaysia (2010)							1	1				
Sasol Limited (2010)					1							
Shree Cement Rajasthan, India (2011)	1							1				
Freeport McMoRan Copper and Gold (2011)							1	1				
Iberdrola (2011)	1											

CASE STUDY	INCOME STATEMENT ELEMENTS							BALANCE SHEET ELEMENTS				
	Lowering operations and maintenance cost	Lowering administrative (incl. legal) costs	Mitigate risk of regulatory costs	Water-related financial costs	Revenue impacts (Increase/ decrease in sales to water-sensitive markets)	Revenue impacts (Water-related product innovation)	Revenue impacts (Ability to operate/ future ability to grow)	Built water-related infrastructure assets	Development of water reserve assets	Development of water-related natural capital assets	Mitigate risk of intangible asset depreciation	Value of current and contingent water-related liabilities
Hennes & Mauritz AB/H&M (2011)	1				1						1	
Woolworths Limited Australia (2012)	1		1					1			1	
Kraft Foods, Davenport, IA (2012)	1							1				
Yunus Textile Mills, Pakistan (2013)	1							1				
Oland Brewery Halifax, Nova Scotia (2013)			1									
Garrison Brewery Halifax, Nova Scotia (2013)			1									
New Hampshire Municipalities (2013)		1	1									
Anonymous Food Processing Plant Midwest (Date unknown)	1		1					1				
Anonymous Sauces, Dressings and Beverages Manufacturing Company (Date unknown)	1							1				
Unilever (Date unknown)					1	1						
Proctor & Gamble (Date unknown)						1						
Philipps Electronics (Date unknown)						1						
Honda Motor Company Ltd. (Date unknown)	1	1			1							
Intel (Date unknown)					1							
Japanese Automotive sector (Date unknown)					1							
Thai garment industry (Date unknown)					1							
TOTALS	19	4	9	1	9	3	3	15	1	0	7	0

6 | CONCLUSION

Amongst the scarcity of a variety of world resources, water, too, comes at a high price. It continues to be considerably undervalued, and as a result, creates both a loss of shareholder value for companies, and economic inefficiency and drag to governments—as well as sub-optimal water stewardship response. Indeed, corporate managers, who are beholden to fiduciary obligation to maximize shareholder value, tend to view water only as a low-price input cost. Such a limited perspective on water-related value not only fails to maximize shareholder value, but also fails to maximize social value as well. Conversely, improved corporate water valuation can lead not only to strong water stewardship responses that, for companies, mitigate water risks and benefit the bottom line, but also generate greater value for economies, society and ecosystems alike.

6.1 | RECOMMENDATIONS

This report has outlined various concepts related to water valuation. The following is a recommended list for companies' approach to water valuation and stewardship:

1. **Understand water's value to different audiences**

   Understand how water creates value for different audiences, and employ appropriate metrics for appropriate audiences. In particular, pay attention to corporate-controlled natural capital assets which *may* hold material future value to corporate audiences and *do* provide present value to society (as well as also affect present brand value). Furthermore, understand your impacts and dependencies on publicly controlled natural capital assets and take advantage of standardized approaches such as the Natural Capital Protocol.

2. **Understand how risk and uncertainty impact the value of water**

   Understand how variables and potentially changing conditions impact the future value of water. Consider how basin and corporate water risks affect the value of your facilities and your company. If you have not already done so, conduct a water risk assessment of the portfolio of your operations to understand water-related materiality.

3. **Include water-related value in your balance sheet and income statement, and discuss both water risk and stewardship response in your annual report.**

   Account for water-related assets beyond grey infrastructure: for the estimated future value of groundwater reserves; for the value of green infrastructure; and for the value of the intangible social capital (community relations/brand value) that relates to reputational risk. Select measures that are important to key internal and external audiences and use these metrics to build better business cases for water stewardship.

4. **When making financial decisions, consider more than just the price of water.**

   Ensure the tools and methods used in various ways in which water affects costs and revenues across operations and maintenance, administration, regulations, and finance are available.

5. **Learn about, and engage in, water stewardship to more fully capture water-related value.**

   Traditional water management with its focus on water prices not only leaves value on the table, but it can also further exacerbate risks and erode long-term value at multiple scales.

6. **Share with investors how water stewardship creates and preserves value.**

   In your annual report, communicate with shareholders about how you are undertaking water risk assessments to maximize shareholder value through water stewardship.

6.2 | CONCLUDING THOUGHTS: A WATER VALUATION FRAMEWORK TO GENERATE BETTER OUTCOMES FOR ALL

The conflicting challenges of seeking to provide water as a fundamental human right, the desire to exploit water resources for economic development, and the under-appreciation for ecosystem services has resulted in a situation in which water resources are coming under increasingly unsustainable pressures. These pressures generate water risks for companies—physical, regulatory and reputational—and have the ability to affect costs

and revenues, as well as assets.

This report has sought to provide a degree of greater understanding to the space of water valuation. A more comprehensive approach to water valuation serves not only corporate and economic development audiences, but also drives value for communities, society and ecosystems as well.

The Water Valuation Framework in this report provides a basis to not only unpack water-related value, but also begin to link value with water risk and water stewardship. Such linkages are critical, since the battle to move beyond a focus on water pricing and water management remains significant for the vast majority of businesses, despite the high financial risks posed from water issues.

Without these linkages, we will continue to see companies respond to risk with the wrong strategies, fail to account for longer-term benefits from engagement, and reject opportunities for external policy improvements by failing to define a "business case." We believe that while water stewardship remains a new concept, it is the only genuine way forward for companies. Making a better case for action that includes longer-term valuation and risk techniques will not only benefit companies today, but other users and company needs in the long run. The alternatives—fighting over scarce resources, skewing policy, ignoring stakeholder concerns—to the point where water access becomes jeopardised are a non-starter. It's easy to value water once you don't have access to it any longer.

While there have been numerous methods and tools applied to the sphere of water valuation, to date no approach has been entirely comprehensive. The framework outlines a more comprehensive approach for valuation tools. With a proposed set of valuation metrics, structured around an income statement and balance sheet, the report has provided a proposed pathway forward for how companies can begin to better integrate the value of water into corporate financial decision making.

In summary, this report highlights the present challenges, clarifies the landscape, provides specific measures in a financial accounting format, and lays the foundation for incorporation of such water valuation approaches into the next generation of tools (*e.g.*, WWF's Water Risk Filter). The hope is that the report provides companies with a clearer pathway forward to not only improve how they value water, but to improve their decision making as well.

WWF and IFC believe the water valuation framework and the insights from this report will provide a key missing piece for corporations: connecting water to shareholder value, water risk, and water stewardship. We invite and encourage companies to begin to employ the framework and metrics outlined here to take action on water to improve shareholder value, while simultaneously benefitting the economy, society, and the environment.

A fisherman in Colombia. **CREDIT:** Edwin Huffman / World Bank

ANNEXES

A.I | GLOSSARY

Built capital: Any pre-existing or planned formation that is constructed or retrofitted to suit human needs. Built capital is built and maintained via human activity.

Business natural capital accounting: The process of systematically recording a business' natural capital impacts and dependencies, assets and liabilities in a consistent and comparable way (Source: Natural Capital Coalition)

Ecological integrity: The condition when the structure, composition, and function of an ecosystem are operating within the bounds of natural or historic disturbance regimes (Source: NatureServe)

Ecological economics: A branch of economics that aims to improve and expand economic theory to integrate the earth's natural systems, human values and human health and well-being

Economics: A social science that studies how individuals, governments, firms and nations make choices on allocating scarce resources (via the production, consumption, and transfer of wealth) to satisfy their unlimited wants. Economics operates from the micro to macro-scale, with economics most commonly used to describe state-level interactions with the private sector and consumers. Put differently, economics in popular discussion is often focused on how governments, through a combination of interest rates, monetary policy, spending, and other means, establish a playing field within which companies and consumers operate. In contrast to macroeconomics, microeconomics is focused on supply, demand and price signals. Economics typically focuses on political economic systems and is heavily tied to government policy and the response of businesses and consumers.

Ecosystem services: The benefits people derive from natural capital

Environmental economics: A distinct branch of economics that undertakes theoretical or empirical studies of the economic effects of national or local environmental policies around the world. Particular issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming. (Source: National Bureau of Economic Research)

Financial accounting: Financial accounting is a specialized branch of accounting that keeps track of a company's financial transactions. Using standardized guidelines, the transactions are recorded, summarized, and presented in a financial report or financial statement such as an income statement or a balance sheet.

Finance: The management of large amounts of money, especially by governments or large companies. As a sub-system of economics, finance is focused on understanding how capital (typically money) is managed and focuses mainly on specific companies and stock markets, and is heavily influenced by financial institutions and markets (*i.e.*, the providers of debt and equity capital). Put simply, economics seeks to understand the environment of finance, while finance most often seeks to understand the status of a specific company.

Green infrastructure: *See "Natural capital."*

Grey infrastructure: *See "Built capital."*

Gross Domestic Product (GDP): An aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs) (Source: OECD definition)

Neo-classical economics: A set of approaches to economics focusing on the determination of prices, outputs, and income distributions in markets through supply and demand

Market value (or market pricing): Measures of water-related value dictated by the free market (*i.e.*, supply and demand combined with subsidies and taxes)

Monetary value (or monetary metrics): Measures of water-related value converted into monetary form

Natural capital: The finite stock of natural assets (air, water, land, habitats) from which goods and services flow to benefit society and the economy. It is made up of ecosystems (providing renewable resources and services), and non-renewable deposits of fossil fuels and minerals. (Source: Natural Capital Coalition). Note that natural capital is generally built and maintained without significant human interference.

Natural capital assessment: The process of estimating, measuring, and documenting characteristics, properties, amounts, and values of natural capital using a wide variety of methods (Source: Natural Capital Coalition)

Natural capital accounting: The process of systematically recording a business' natural capital impacts and dependencies, assets and liabilities in a consistent and comparable way

Non-use value: The utility or value that people assign to economic goods (including public goods) even if they never have and never will use it

Opportunity cost: The cost of an alternative that must be forgone in order to pursue a certain action

Stranded asset: (from water challenges; also linked to the notion of "drying and drowning assets") This term has seen considerable use both in relation to extreme weather events (notably droughts—"drying" and flooding—"drowning"), but also in the context of incidents where a facility's social license to operate has been jeopardized (*i.e.*, assets may be stranded due to physical, regulatory or reputational water risk issues).

Use value: The utility or value of consuming a good or service

Value-at-Risk: The maximum loss not exceeded with a given probability defined as the confidence level, over a given period of time

Value of water to business: The monetary value of assets, liabilities, revenues and costs at the facility and corporate levels under varying levels of risk

Water risk (corporate): The probability and financial impact exposure deriving from physical, regulatory and reputational conditions at the basin level, and the nature of the corporate activity

Water in the economy: One common meaning is a non-valuation-based interpretation that explores how water 'virtually' moves through an economy. An example would be Tony Allan's Virtual water theory also linked to water footprint, embedded water or embodied water. This discussion of water in the economy seeks to understand how water used to produce goods and services moves from one national (or regional) economy to another. The concept originated seeking to improve the understanding of water's association with economic trade flows between states (via virtual water trade), and the associated water use policies (as exemplified through reports such as Bhatia et al (2006). Such "opportunity cost" (the cost of the next best opportunity foregone) evaluations have allowed economists to compare the value of crops grown per unit of water vs. the value of energy created/sold per unit of water vs. the value of manufactured goods per unit of water. This enables value-based comparisons of how water is contributing to any given economy (*e.g.*, job creation, tax revenue, etc., per m3 of water use). More recently, the concept has also been used to explore the role that freshwater ecosystem services play in economic development and productivity. Water in the economy often explores the role of national economic accounting and may consider the role of ecosystem services, since the costs and benefits of such natural capital assets are traditionally felt by the public sector more so than the private sector. In summary, a more comprehensive approach to accounting for water's role in the economy is necessary to optimize water allocations for economic (as well as social and environmental) growth.

Water stewardship: The use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions. Water stewardship is a form of water risk mitigation that seeks to preserve and create value at multiple scales and levels of certainty.

Water valuation: The process of determining the monetary and non-monetary value of water-related stocks and flows at various spatial scales to different audiences under varying levels of certainty. For businesses specifically, water valuation seeks to determine the monetary value of assets, liabilities, revenues and costs at the facility and corporate levels under varying levels of risk.

Well-being: The state of being healthy, happy, or prosperous

A.2 | VALUATION CASE STUDIES

VALUE DRIVERS	Woolworths Limited Australia 2012	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets Mitigate risk of **intangible asset** depreciation Mitigate risk of **regulatory costs**	**WATER-RELATED ISSUE:**	Desire to track water use, eliminate use inefficiencies, and monitor the overall health of processing systems
	ACTION:	Installed refrigeration and air conditioning systems at two distribution centers that utilize rainwater harvesting; [i] installed water metering devices[ii]
	FINANCIAL BENEFITS:	2-3 year return on investment where water bills are over $5,000[iii]
	WATER BENEFITS:	Water initiatives across the company reduced Woolworths' water use by 208 ML (54.9 million gallons)[iv]
	CO-BENEFITS:	Positive impacts to business continuity and reputation; meeting of compliance requirements; reduction in energy use[v]

VALUE DRIVERS	Mariani Packing Company Vacaville, CA 2006	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets Mitigate risk of **regulatory costs**	**WATER-RELATED ISSUE:**	Closure of the Publicly Owned Treatment Works plant to which the company sent its waste
	ACTION:	Built an on-site water pre-treatment plant that handles additional biochemical oxygen demand (BOD) levels
	FINANCIAL BENEFITS:	Potential to result in decreased wastewater treatment and disposal fees
	FINANCIAL COSTS:	Investment in plant
	WATER BENEFITS:	TSS reduction from 1,500-3,000 to less than 10 ppm[vi]

VALUE DRIVERS	Food Processing Plant Midwest (Anonymous)	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets Mitigate risk of **regulatory costs**	**ACTION:**	Installation of an additional water treatment system for optimized solids recovery
	FINANCIAL BENEFITS:	Ability to meet Publicly Owned Treatment Works limits=$100,000 in annual cost savings
	FINANCIAL COSTS:	Investment in water treatment system
	WATER BENEFITS:	Improvement in sludge solids level from less than 1% to more than 27% solids by weight; 25% improvement in turbidity, TSS, and COD of plant effluent versus the previous treatment protocol; almost 100% FOG removal [vii]

VALUE DRIVERS	Sauces, Dressings, and Beverage Manufacturer (Anonymous)	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**ACTION:**	Implemented use of BOD-consuming bacteria in pH neutralization tank
	FINANCIAL BENEFITS:	$175,000 annual savings in treatment surcharges
	FINANCIAL COSTS:	Purchase of and system modifications for use of bacteria
	WATER BENEFITS:	42% reduction in mean BOD levels; 65% decline in variability[viii]

VALUE DRIVERS	Colgate Palmolive Morristown, NJ (2009)[ix]	
Lowering **operations and maintenance** costs	**WATER-RELATED ISSUE:**	Product requires very high-quality water, so large quantities of water of a high quality, but not high enough for use in the product, were being discharged from plant
	ACTION:	Began purifying and reusing rejected water on-site through existing process
	FINANCIAL BENEFITS:	$250,000 annual cost savings
	FINANCIAL COSTS:	No known costs
	WATER BENEFITS:	Water savings of 26 gallons per minute; 95% reduction in water waste

VALUE DRIVERS	Cisco Systems 2009-2010	
Lowering **operations and maintenance** costs	**WATER-RELATED ISSUE:**	Discovered that it was possible to maintain product quality without a water-intensive wash stage of the manufacturing process[x]
	ACTION:	Company-wide implementation of a soldering practice that eliminates said wash stage
	FINANCIAL BENEFITS:	$1 million annual cost savings
	WATER BENEFITS:	20 million gallons of water saved[xi]

VALUE DRIVERS	Ford Motor Company Chihuahua City 2010[xii]	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**WATER-RELATED ISSUE:**	Water stress in region where plant is located; particularly scarce groundwater resources in the face of increased pumping by the plant
	ACTION:	Began using reverse osmosis-treated gray water from the city's water system for manufacturing processes, washing equipment, and washing floors in the facility
	FINANCIAL BENEFITS:	Annual cost savings of $65,500
	WATER BENEFITS:	Annual reduction in water use of over 32,000 cubic feet

VALUE DRIVERS	Kraft Foods Davenport, IA 2012[xiii]	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**WATER-RELATED ISSUE:**	Desire to reduce electricity use for removing heat from refrigerated systems; desire to reduce natural gas use for heating water for sanitation
	ACTION:	Implemented use of ammonia heat pump
	FINANCIAL BENEFITS:	Annual operating cost savings of $267,407
	WATER BENEFITS:	21 million gallons of annual water savings

VALUE DRIVERS	Kraft Foods Jacksonville, FL 2009	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**WATER-RELATED ISSUE:**	Corporate goal to reduce water use by 21 per cent in 3 years
	ACTION:	Installation of closed-loop system to reuse water in coffee-grinding equipment cooling
	FINANCIAL BENEFITS:	Reduction in water purchasing requirements
	WATER BENEFITS:	20 million gallon reduction in water use[xiv]

VALUE DRIVERS	Starbucks Coffee Company 2009	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets Mitigate risk of **regulatory costs**	**WATER-RELATED ISSUE:**	Criticism by environmental groups for continuously leaving the water running to clean spoons in its stores[xv]
	ACTION:	Installation of manually operated hand-meter faucets
	FINANCIAL BENEFITS:	Reduction in water utility bills (2014 = 21,366 stores x 100G/day x $0.008106/G (2014 GWI value of $2.13/m3) x 365 days = $17K/day = $6.32M/yr
	FINANCIAL COSTS:	Investment in new faucets
	WATER BENEFITS:	Water savings of 100 gallons per store per day[xvi]

VALUE DRIVERS	Hennes & Mauritz AB (H&M) 2010	
Lowering **operations and maintenance** costs Mitigate risk of **intangible asset** depreciation	**ACTION:**	Implementation of the "Cleaner Production Programme" to engage suppliers in water-scarce areas, on water performance
	FINANCIAL BENEFITS:	
	FINANCIAL COSTS:	
	WATER BENEFITS:	10-30% water savings per mill in 21 mills[xvii]

VALUE DRIVERS	Finlays Tea 2009[xviii]	
Lowering **operations and maintenance** costs Mitigate risk of **regulatory costs**	**WATER-RELATED ISSUE:**	Pressure from local utility to reduce BOD of waste water
	ACTION:	Installation of a liquid/solid separator
	FINANCIAL BENEFITS:	Return on investment within six months due to minimizing penalty fines for high BOD levels
	WATER BENEFITS:	Reduction in wastewater; reduction in municipal water use

VALUE DRIVERS	Yunus Textile Mills, Pakistan (2013) [xix]	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**WATER-RELATED ISSUE:**	Desire to increase sustainability of their operations
	ACTION:	Installation of bioreactor wastewater treatment plant and membrane-based ultra-filtration plant
	FINANCIAL BENEFITS:	Reduced cost of water purchases
	FINANCIAL COSTS:	Cost of plant installation and maintenance
	WATER BENEFITS:	Daily reduction of water use by 800,000 gallons

VALUE DRIVERS	Shree Cement Rajasthan, India (2011) [xx]	
Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**WATER-RELATED ISSUE:**	Location in semi-arid, water-scarce region and desire to fulfill its company policy of 100% utilization of wastewater
	ACTION:	(1) Installation of reverse osmosis water recycling facilities; (2) installation of sewage treatment plants in five of its locations; (3) installation of ACCs at all of its power plants
	FINANCIAL BENEFITS:	Water recycling and reuse has saved $55,153 annually; sewage treatment plants have saved $16,680; cost effectiveness of ACCs is $1.76 per cubic meter of water saved, ACCs have saved the company 793,500 cubic meters of water per year, approximate cost savings from ACCs= $1,396,560 annually
	FINANCIAL COSTS:	(1) Capital investment of $281,250 and annual operating cost of $46,819; (2) capital cost of $558,334; (3) capital cost between $15.52 and $17.38 million for each plant
	CO-BENEFITS:	Received several national and international awards for implementing above water management efforts, including recognition by the World Economic Forum as Sustainability Champions.

VALUE DRIVERS	Unilever[i]	
Revenue impacts (New or expanded water-sensitive markets & water-related product innovation)	**PRODUCT:**	Pureit—an in-home water purifier that works without electricity or pressurized tap water
	FINANCIAL BENEFITS:	Profits from product
	WATER BENEFITS:	Pureit has provided clean drinking water to over 25 million customers; aims to reach 500 million people worldwide by 2020.

VALUE DRIVERS	Proctor and Gamble[ii]	
Revenue impacts (Water-related product innovation)	**PRODUCT:**	PUR packet
	FINANCIAL BENEFITS:	Profits from product
	WATER BENEFITS:	3 billion liters of clean drinking water delivered thus far

VALUE DRIVERS	Phillips Electronics[iii]	
Revenue impacts (Water-related product innovation)	**PRODUCT:**	UV lamps for water purification
	FINANCIAL BENEFITS:	Profits from product
	WATER BENEFITS:	Efficient process for water purification

VALUE DRIVERS	Southern Company 2007-2008[1]	
Lowering **operations and maintenance** costs Development of **water reserve assets**	**SITUATION:**	Drought conditions reached D4— "exceptional drought"—over much of the Southeastern United States[2]
	IMPACTS:	Production of hydroelectricity was reduced to 50% of normal capacity; Southern Company forced to replace hydroelectricity with higher-cost power sources
	FINANCIAL COSTS:	$200 million
	MITIGATION:	Increased diversity of energy portfolio; created storage ponds at key facilities; worked with government agencies on contingency plans for subsequent periods of drought[3]

VALUE DRIVERS	Nestle, South Africa 2009[4]	
Water-related **financial costs** Lowering **operations and maintenance** costs **Built water-related infrastructure** assets	**SITUATION:**	Drought (classified as "disaster" and resulting in the need for 108.5 million Rand in assistance for one municipality alone) in the Western Cape region of South Africa[5]
	ACTION:	Reduced water usage by 13,500 cubic meters per month through installation of condensate recovery equipment and water-saving retrofits
	FINANCIAL COSTS:	$222,658

VALUE DRIVERS	Freeport McMoRan Copper and Gold (2011)	
Built water-related infrastructure assets **Revenue impacts** (Ability to operate/ future ability to grow)	**SITUATION:**	Rapid decrease of water supplies in the Copiapo River Aquifer in northern Chile for local communities, farmers, and other mining operations
	ACTION:	Constructed desalination plant and pipeline to meet long-term operational water needs
	FINANCIAL COSTS:	$300 million[6]

VALUE DRIVERS	Kimberly-Clark Kluang, Malaysia 2010[7]	
Built water-related infrastructure assets **Revenue impacts** (Ability to operate/ future ability to grow)	**SITUATION:**	Seasonal drought
	ACTION:	Production curtailment
	FINANCIAL COSTS:	$2 million
	MITIGATION:	Installation of effluent recycling and other technologies to ensure more secure future water supplies

VALUE DRIVERS	Iberdrola 2011	
Lowering **operations and maintenance** costs	**SITUATION:**	Decrease in availability of water
	IMPACTS:	22.1% rise in procurement costs from 2010
	FINANCIAL COSTS:	9.6 million euros[8]

VALUE DRIVERS	Honda Motor Company Ltd.	
Lowering **operations and maintenance** costs	**IMPACTS:**	Damage to inventory, machinery, and equipment of Honda subsidiaries and affiliates negatively impacted production
Revenue impacts (Cost of sale) Lowering **administrative** costs	**FINANCIAL COSTS:**	Honda's losses totaled $174,590,272 in costs and expenses; $94,517,703 in losses were in cost of sales; $80,159,309 were in selling, general, and administrative expenses[1][1]

VALUE DRIVERS	Intel	
Revenue impacts (Ability to operate/ future ability to grow)	**IMPACTS:**	Damaged or dismantled hard-drive manufacturing operations led to a slowing in PC production
	FINANCIAL COSTS:	Intel fell $1 billion short of profit projections[2]

VALUE DRIVERS	Japanese Automobile Industry	
Revenue impacts (Ability to operate/ future ability to grow)	**FINANCIAL COSTS:**	$450 million loss in profits[3]

VALUE DRIVERS	Thai Garment Industry[4]	
Revenue impacts (Ability to operate/ future ability to grow)	**IMPACTS:**	Floods affected around 22 textile companies and 142 garment companies in Thailand, stopping around 25% of garment production in Thailand.
	FINANCIAL COSTS:	

The following two case studies highlight financial damages from recent floods other than the Thailand floods of 2011.

VALUE DRIVERS	Sasol Limited 2010[5]	
Revenue impacts (Ability to operate/ future ability to grow)	**SITUATION:**	Flooding of the Sasol Synfuels Plant
	IMPACTS:	Production Losses
	FINANCIAL COSTS:	$15.6 million

VALUE DRIVERS	H&M 2011	
Revenue impacts (Ability to operate/ future ability to grow) Lowering **operations and maintenance** costs Mitigate risk of **regulatory costs**	**SITUATION:**	Extreme rain events in India, Pakistan, and Australia coupled with increased demand for cotton
	IMPACTS:	Price of cotton skyrocketed to record highs of over $1.90 per pound[6]
	FINANCIAL COSTS:	In an effort to maintain their "cheap chic" brand by insulating consumers from rising prices, H&M profits dropped 30% to $4 billion[7]

VALUE DRIVERS	Oland Brewery Halifax, Nova Scotia 2013[i]	
Water-related **regulatory costs**	**REGULATION:**	Local utility Halifax Water plans to increase effluent surcharges by 396% for BOD and 320% for TSS; plans to increase water rates by 50%
	FINANCIAL COSTS:	Company expects its water bill to increase by $1 million.

VALUE DRIVERS	Garrison Brewing Halifax, Nova Scotia 2013[ii]	
Water-related **regulatory costs**	**REGULATION:**	Local utility Halifax Water plans to increase rates by 50% for businesses
	FINANCIAL COSTS:	Company expects its water bill to increase from $20,000 to $30,000

VALUE DRIVERS	Duro Textiles Massachusetts 2007[iii]	
Water-related **regulatory costs**	**REGULATION:**	EPA standards for wastewater discharge under the Clean Water Act
Water-related **litigation costs**	**FINANCIAL COSTS:**	$480,000 in fines; litigation costs

VALUE DRIVERS	New Hampshire Municipalities 2013[iv]	
Water-related **regulatory costs**	**REGULATION:**	EPA to implement new TMDL and runoff standards
Water-related **litigation costs**	**FINANCIAL COSTS:**	Non-compliance fines of up to $37,000 per day with compliance potentially more costly than fines; estimated compliance costs for City of Manchester= $750 million; estimated costs of contracting with law firm to fight the new standards=$350,000 shared across 26 towns.

VALUE DRIVERS	Cameron Bridge Distillery 2005[i]	
Mitigate risk of **intangible asset** depreciation **Revenue impacts** (Ability to operate/ future ability to grow) **Built water-related infrastructure** assets	**SITUATION:**	The distillery, named "Scotland's most polluting industrial site" in 2005 by the Scottish EPA, was unable to expand due to water shortages and rising pollution.
	FINANCIAL COSTS:	The company was forced to invest $100 million to cut wastewater discharge by 30%; it also began reusing distilling by-products in biogas for its steam boiler instead of dumping them in the Firth of Forth.

VALUE DRIVERS	The Coca Cola Company Kerala, India 2004[i]	
Mitigate risk of **intangible asset** depreciation **Revenue impacts** (Ability to operate/ future ability to grow) **Built water-related infrastructure** assets Water-related **regulatory costs** Water-related **litigation costs**	**SITUATION:**	Coca-Cola was involved in an ongoing legal battle regarding water withdrawals and water quality with regards to their Kerala, Plachimada, plant; despite ultimately winning a case in the Indian Supreme Court allowing the plant to stay open, negative publicity forced Coke to keep the plant closed.
	FINANCIAL COSTS:	Plant was worth $25 million;[ii] litigation costs

VALUE DRIVERS	The Coca Cola Company Ann Arbor, MI 2006[iii]	
Mitigate risk of **intangible asset** depreciation **Revenue impacts** (Decrease in sales to water-sensitive markets)	**SITUATION:**	Protests against Coke's water use practices in Kerala and labor practices in Columbia resulted in removal of Coke products from the University of Michigan from Jan-Apr 2006, despite the fact that some of the protesters' accusations were unfounded.
	FINANCIAL COSTS:	Loss of sales from all vending locations and on-campus eateries

A.3 | WATER VALUATION INITIATIVES

INITIATIVE	DESCRIPTION	LEAD ORGANIZATION(S)	APPROACH TO VALUATION	WATER SPECIFIC?	CATEGORY OF TOOL			PUBLICLY AVAILABLE
					FRAMEWORK	DATA/ DATABASE	SOFTWARE/ CALCULATOR	YES/NO
Water Impact Index	Water impact footprinting tool **WEBSITE:** http://www.veoliawaterst.com/sustainability/water-footprint/water-footprint-indicator/	Veolia	N/A	Yes			x	
True Cost of Water Tool	A methodology for monetizing water-related costs, including risks, for business and strategic planning **WEBSITE:** http://www.veoliawaterst.com/sustainability/true-cost-water/	Veolia	Various	Yes	x		x	
Water Risk Monetizer Tool	Online tool to calculate the estimated risk-adjusted future cost of water at a site level to inform decisions that improve business vitality **WEBSITE:** http://waterriskmonetizer.com	Ecolab, Trucost	Risk-adjusted water pricing	Yes			x	Yes
Valuing Natural Capital in Business: Towards a Harmonized Framework	Outlines the Natural Capital Protocol project, provides a high-level summary of the stock take results and a proposed straw man/draft outline for the Protocol for consultation. **WEBSITE:** http://www.naturalcapitalcoalition.org/js/plugins/filemanager/files/Valuing_Nature_in_Business_Part_1_Framework_WEB.pdf	Natural Capital Coalition	Ecosystem service valuation	No	x			Yes
Valuing Natural Capital for Business: Taking Stock	Existing initiatives and applications is a compilation summarising existing initiatives to provide a baseline on the existing landscape as follows. This is intended as a useful resource to demystify the growing volume of initiatives in this space. **WEBSITE:** http://www.naturalcapitalcoalition.org/js/plugins/filemanager/files/Valuing_Nature_in_Business_Part_2_Taking_Stock_WEB.pdf	Natural Capital Coalition	Ecosystem services valuation	No	x			Yes
ARIES	Standing for Artificial Intelligence for Ecosystem Services, ARIES is an integrated ecosystem services modeling methodology and web-accessible platform. It allows users to map, model, and quantify ecosystem services flow, and deliver between source and use locations. **WEBSITE:** http://www.ariesonline.org/	Basque Centre for Climate Change, University of Vermont, Conservation International	Ecosystem services valuation	No			x	Yes
Co$ting Nature	A web-based tool for analysing ecosystem services, identifying beneficiaries of those services, and assessing the impacts of human interventions such as land use change upon them. **WEBSITE:** http://www.policysupport.org/costingnature	King's College London (models), AmbioTEK (software), and UNEP-WCMC	Ecosystem services valuation	No			x	Yes
Ecologically Based Life Cycle Assessment	An online accounting system software that quantifies the direct and indirect role of various natural resources for supporting various economic activities. **WEBSITE:** http://resilience.eng.ohio-state.edu/eco-lca/	The Centre for Resilience, Ohio State University	Input-output / LCA	No			x	Yes?

INITIATIVE	DESCRIPTION	LEAD ORGANIZATION(S)	APPROACH TO VALUATION	WATER SPECIFIC?	CATEGORY OF TOOL			PUBLICLY AVAILABLE
					FRAMEWORK	DATA/DATABASE	SOFTWARE/CALCULATOR	YES/NO
Natural Capital project—Integrated Valuation of Environmental Services and Trade-offs (InVEST)	A free, open-access software tool for mapping, quantifying and valuing ecosystem services at the site or landscape scale. InVEST quantifies nature's benefits in both biophysical terms, such as water flows, and economic terms, such as avoided cost or net present value. **WEBSITE:** http://www.naturalcapitalproject.org/InVEST.html	Stanford University, University of Minnesota, WWF, and The Nature Conservancy	Ecosystem services valuation	No			x	Yes
PwC Total Impact Measurement and Management (TIMM)	PwC's TIMM framework helps business leaders and stakeholders understand how a business' activities contribute to the economy, public finances, the environment and wider society. By valuing social, environmental, tax and economic impacts, business is now able to compare the total impacts (both positive and negative) of their strategies and investment choices. It allows leaders to see at a glance not only the impact, but also the trade-offs between alternative strategies and to identify the optimal decision for stakeholders. **WEBSITE:** http://www.pwc.com/gx/en/sustainability/publications/total-impact-measurement-management/index.jhtml	PwC		No	x			No?
Simple Effective Resource for Valuing Ecosystem Services (SERVES)	A subscription-based tool for rapid, preliminary estimates of the value of an area's ecosystem services. SERVES uses benefits transfer to obtain an estimate for the value of ecosystem services through the analysis of valuation studies that have been previously carried out to value similar goods or services in similar geographies and contexts. **WEBSITE:** http://www.esvaluation.org/serves.php	Earth Economics	Ecosystem services valuation	No			x	No
Systain (estell)	An extended multi-regional input-output model covering 45 regions and 130 sectors, used to gain transparency on the impacts caused by business activities **WEBSITE:** http://www.systain.com/fileadmin/Dateien_Systain/Daten/Download_Dokumente/sys_Folder_estell_engl.pdf	Otto Group	Input-output	No			x	No
Total Contribution	A way to measure the broader value that a company creates across economic, social and environmental indicators. As well as covering direct impacts, Total Contribution goes further to account for the impacts of supply chains (indirect) and the enabled contribution of others on The Crown Estate land. **WEBSITE:** http://www.thecrownestate.co.uk/about-us/total-contribution/	The Crown Estate, NEF Consulting, Route2Sustainability, Landman Economics		No			x	?

INITIATIVE	DESCRIPTION	LEAD ORGANIZATION(S)	APPROACH TO VALUATION	WATER SPECIFIC?	CATEGORY OF TOOL			PUBLICLY AVAILABLE
					FRAMEWORK	DATA/ DATABASE	SOFTWARE/ CALCULATOR	YES/NO
Trucost Natural Capital Analyzer	Enables companies to assess the environmental impacts and natural capital costs associated with company operations and supply chains through a secure online data platform. Using the Natural Capital Analyzer, companies can screen high-impact operating sites and suppliers, assess financial risk and opportunity from regional natural capital cost scenarios, including carbon taxes, water availability and land use, and manage natural capital impacts through customisable dashboards and reports. **WEBSITE:** http://www.trucost.com/naturalcapitalanalyzer	Trucost		No			x	No?
Climate Earth Natural Capital Management System (NCMS)	NCMS is a cloud-based software system that allows a company to gain insight and actively manage the risks and opportunities associated with natural capital consumption. **WEBSITE:** http://www.climateearth.com/ncms/			No			x	No
Environmental Risk, Opportunity and Valuation Assessment (EROVA) Tool	A flexible framework-based tool that helps companies evaluate their impacts, dependencies, risks, and opportunities associated with natural capital; e.g., biodiversity and minerals and other environmental parameters such as GHG emissions, noise and dust. The approach allows qualitative, quantitative, and monetary valuation of landholdings and project impacts, as well as assessing the distribution of values and impacts among stakeholders. **WEBSITE:** http://www.sustainvalue.co.uk/EROVA.php	Sustain Value, Antofagasta Minerals S.A.		No	x			No?
Externality Valuation Assessment Tool (E.Va-lu.A.Te)	A suite of resources that brings together comprehensive guidance for environmental externality assessment, stimulated directly by business needs **WEBSITE:** http://www.cisl.cam.ac.uk/Business-Platforms/Natural-Capital-Leaders-Platform.aspx	CPSL Natural Capital Leaders Platform		No	x		x	No
ENVALUE database	The ENVALUE environmental valuation database, developed by the New South Wales Environmental Protection Agency and first released in 1995, is a systematic collection of environmental valuation studies presented in an on-line database. **WEBSITE:** http://www.environment.nsw.gov.au/envalueapp/	New South Wales Environmental Protection Agency		No				
Environmental Valuation Reference Inventory (EVRI)	EVRI is a searchable storehouse of more than 2,000 empirical studies on the economic value of environmental benefits and human health effects. **WEBSITE:** https://www.evri.ca/Global/HomeAnonymous.aspx			No		x		

ACKNOWLEDGEMENTS

The report was prepared by Alexis Morgan and Stuart Orr of the World Wide Fund for Nature with support provided by the International Finance Corporation and with early ideas funded by the WWF–USA and Ecolab.

The report was reviewed, edited, and revised by Alex Burger with the help of Shilpa Banerji all under the guidance and leadership of Veronica Nyhan Jones of the International Finance Corporation.

The report also benefited greatly from the comments of Emily McKenzie (WWF–UK), Jochem Verberne (WWF–International), Oliver Männicke (WWF–International), Rachel Jacobson (WWF Intern), Arjun Bhalla (IFC), David Poulter (IFC) John Middleton (IFC), William Llwelyn Davies (IFC), and Nathan Monash (Lundin Gold). And additional thanks to Toniqua Hay for help with the photographs.

The report was designed by Rikki Campbell Ogden, with final edits by Elsie Williams.

ABOUT WWF

WWF is one of the world's largest and most respected independent conservation organizations, with over 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the Earth's natural environment and to build a future in which humans live in harmony with nature by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

ABOUT IFC

IFC, a member of the World Bank Group, creates opportunity for people to escape poverty and improve their lives. We foster sustainable economic growth in developing countries by supporting private sector development, mobilizing private capital, and providing advisory and risk mitigation services to businesses and governments.

WWF International | International Finance Corporation

AUGUST 2015