A Practical Perspective on Water Accounting in the Beverage Sector

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Beverage Industry Environmental Roundtable

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PROLOGUE

As part of a unified effort to reduce the environmental impact of the beverage industry, leading companies within the sector formed the Beverage Industry Environmental Roundtable (BIER) in August 2006. The members of this Roundtable work as a team to identify ways to reduce water, energy and greenhouse gas impacts across the enterprise value chain and life cycle of beverage products.

In 2010, a working group was formed to evaluate and address the increasing global efforts to develop water footprinting methodologies, particularly as they apply to the beverage sector. Several BIER member companies have developed product water footprints using these methodologies. *"A Practical Perspective on Water Accounting in the Beverage Sector"* is a document created by BIER members to guide beverage companies in the application of existing and developing water footprinting tools. It provides clarification and consistency in the quantification of beverage water usage and consumption. BIER members are developing a companion document that discusses the application of developing methodologies to identify and prioritize water risks from a business perspective.

Several organizations, most notably the Water Footprint Network and the International Organization for Standardization, are developing detailed water footprinting methodologies and technical guidance. Several BIER members are actively participating in this development. This document should be viewed as complementary to these efforts, not as competing or conflicting. Beverage companies are encouraged to consult these methodologies as they are developed and use them where applicable.

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PREFACE

BIER members have defined World Class Water Stewardship in the Beverage Industry around six leadership principles.

Leaders Act with the understanding that:

1. Water is a finite and shared resource
2. Continuous improvement of water efficiency is fundamental to operational excellence

Leaders Engage and Communicate with the understanding that:

3. Community engagement is essential for sustained solutions
4. Partnerships lead to more effective water management
5. Open and honest communications define transparency

Leaders work to Influence with the understanding that:

6. Responsibility for water stewardship extends throughout the value chain

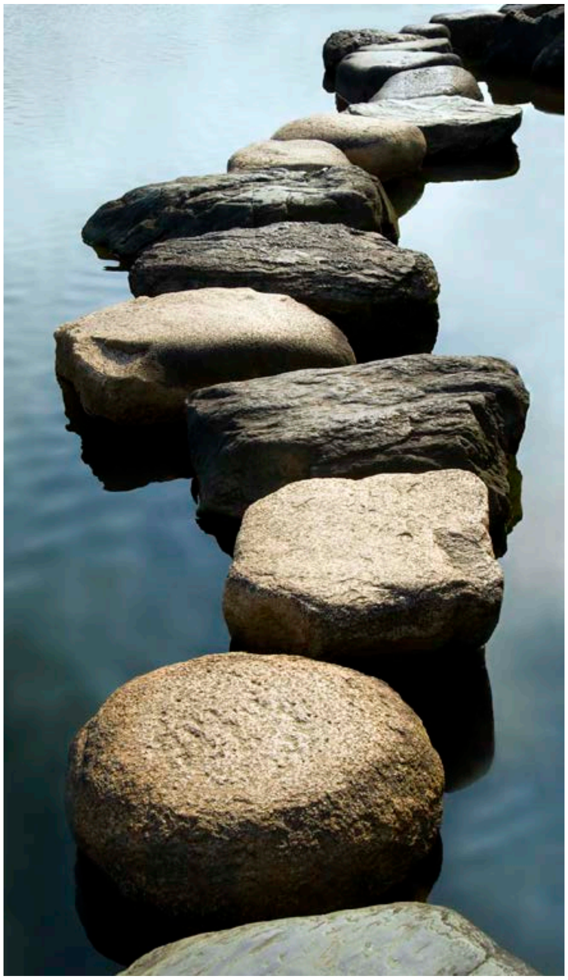
"*A Practical Perspective on Water Accounting in the Beverage Sector*" has been developed by BIER for the purpose of achieving consistency in water footprinting for the beverage industry. This *Sector Perspective* provides beverage industry specific information and examples that improve the ability to measure and account for water withdrawal, consumption and wastewater discharge throughout the value chain. The focus of this perspective is primarily in those areas where beverage companies have the greatest potential for impact and have the greatest opportunity for improvement.

Some beverage companies may find this document useful in helping to create a water footprinting analysis of their products and/or organizational entity. Although this document is intended to assist in the development of a beverage water footprint, no guarantee is made on behalf of BIER members to complete or publicly report the results of such an assessment.

ACKNOWLEDGMENTS

A Practical Perspective on Water Accounting in the Beverage Sector" was developed through a collaborative effort of BIER. The global beverage companies which participate in BIER have developed this perspective in an effort to better understand water use and consumption associated with the beverage sector. This work product supports BIER's mission of establishing a common framework for leadership in the realm of water stewardship.

INTRODUCTION



As the issues of increasing population and climate change advance on the list of global priorities, businesses are developing strategies to ensure sustainable usage of water resources. For the beverage sector, as for many industries, a critical first step is to properly inventory water and wastewater across the value chain.

There are numerous organizations currently engaged in addressing water usage, impacts and risks from an overall water stewardship viewpoint. For example, the World Business Council for Sustainable Development (WBCSD) has attempted to capture the major business-relevant initiatives that address the challenge of better defining sustainable water management through a Global Water Tool[1]. The Water Footprint Network (WFN) has published a methodology to quantify water consumption and risks across the value chain using the term water footprinting[2]. The International Organization for Standardization (ISO) is drafting water footprint requirements and guidelines under ISO 14046[3]. These are just a few of the major efforts focused on this important subject.

This document is not intended to be a stand-alone tool. It is complementary to existing methodologies available from the organizations listed above. Beverage companies are encouraged to use this perspective for clarification and for addressing specific beverage sector issues which may not be fully identified in existing guidance documents.

A company's ability to accurately develop a value chain water inventory on a localized watershed basis is a critical component in determining potential business impacts, risks, opportunities and mitigation options. The collection of meaningful data is a complicated and difficult undertaking. The United Nations Environment Programme (UNEP) recently commissioned a report (UNEP Report)

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[1] Water for Business; March 2010

[2] Arjen Y. Hoekstra, Ashok K. Chapagain, Maite M. Aldaya and Mesfin M. Mekonnen, The Water Footprint Assessment Manual, Setting the Global Standard, 2011.

[3] Water Footprint – Requirements and Guidelines, ISO 14046 Working Draft, March 2010.

in conjunction with the CEO Water Mandate to identify obstacles and potential solutions which would advance global water stewardship efforts.[4]

The UNEP Report identified six key areas in which water accounting practices can be improved through emerging practices:

1. Reaching consensus on the term and concept "water footprinting";
2. Developing effective "local context" metrics for individual watersheds and communities;
3. Developing a consistent approach to measure and communicate water related information relevant to an industry sector;
4. Improving the collection of primary data at the watershed level;
5. Creating innovative ways to communicate and incentivize suppliers to address water related issues;
6. Improving the accounting of wastewater discharge quantity and quality and ambient watershed conditions.

Finally, the UNEP Report urges cooperation among companies to pool their resources to better measure and contextualize their relationship with local water resources. Companies can advance water stewardship by sharing policies and programs, watershed and supplier data, mitigation techniques and effective reporting criteria.

Beverage Industry Environmental Roundtable (BIER) members have accepted the challenge identified in the UNEP Report through cooperation and sharing of best practices to create this sector perspective. The intent of BIER is to inventory and report water footprints in a way that will help build awareness, create information that drives action and assist in meeting the growing demands from key organizations and stakeholders, such as:

- *Governments* that seek to regulate and provide incentives for businesses to reduce their water use;

- *Non-Governmental Organizations* that request product-specific water use data from industry;

- *Customers* that have begun to engage their suppliers for water use accounting; and

- *Consumers* who are increasingly aware of the impacts of the products they purchase and of the businesses that provide them.

Disjointed efforts by individual beverage companies may lead to complications, such as competing or incompatible methodologies and potentially misleading communication to stakeholders. Therefore, the work to create this perspective represents a unified approach to measuring and

[4] Corporate Water Accounting – An Analysis of Methods and Tools for Measuring Water Use and Its Impacts, Pacific Institute, 2010

reporting water footprints and the industry's intent to play a constructive and proactive role in promoting water stewardship.

It should be noted, however, that while *"A Practical Perspective on Water Accounting in the Beverage Sector"* allows for a more consistent approach, this perspective is not designed to create one number for the purpose of comparing beverage products. The unique spatial and temporal characteristics of water footprinting make direct comparisons very difficult, if not impossible, to achieve.

As a final note, this is a "living document." As water footprinting data collection, estimation and reporting guidelines continue to evolve; we expect protocols and standards to develop concurrently, and at a rapid pace.

1.0 Beverage Sector Approach to Water Footprinting

The term and concept "water footprinting" has been defined in varying ways by different entities. Reaching consensus on the term and concept "water footprinting" is listed as one of the key initiatives in the UNEP Report regarding water accounting practices. Beverage companies should consult the "The Water Footprint Assessment Manual, Setting the Global Standard" (WFN Manual) for a base understanding of water footprinting methodology and terms. BIER has further defined terms and concepts as noted below to capture specific implications of a water footprint for the beverage sector.

Many beverage companies have completed a product carbon footprint which totals the quantity of Greenhouse Gas (GHG) emissions across a product lifecycle in units such as grams of CO_2 equivalent per liter of beverage. The summing of GHG emissions at each step in the value chain and calling it a "footprint" may lead to confusion in the context of terminology used in water footprinting methodologies. Since climate change impacts are a global issue, there is typically no attempt to determine the localized impact of GHG emissions on the environment. In addition, there is no attempt to identify other potential social issues that may occur as a result of these emissions.

In contrast, a water footprint reflects the usage, consumption and impact of water resources across the beverage value chain. For example, it is critical to define where the water is withdrawn and where wastewater is discharged. It is also critical to determine when the water is withdrawn and when it is discharged. The timing of water withdrawal and discharge can have significant consequences due to seasonal variation in precipitation and watershed demands. Unlike carbon, these parameters are very relevant to the potential impacts and risks of beverage sector water usage, consumption and wastewater discharge.

Future BIER work will focus on the development of a beverage sector perspective to determine the business risks, opportunities and mitigation best practices associated with a water footprint. This work will be the focus of a follow-up document to be released by BIER in 2012.

1.1 Blue, Green and Grey Water Footprint

The *WFN Manual* introduces the terms blue, green and grey water as components of a footprint. Please refer to the *WFN Manual* for full definitions of these terms. It is important for beverage companies to distinguish between the types of water. In essence, a blue water footprint refers to the volume of surface and groundwater consumed as the result of producing a beverage. Most direct water usage for a beverage company will be blue water pumped from on-site aquifers or purchased through a third party water supplier. Historically, this has been the primary focus of beverage companies for water usage inventory and reduction. Blue water is expected to be the major component of most non-agricultural indirect water use in a beverage company's value chain. It is also important to understand the timing of usage and consumption of blue water from surface and groundwater sources.

A green water footprint refers to the volume of rainwater consumed as a result of producing a beverage. For a beverage company with agricultural inputs, green water can be a large percentage of total water consumption. Green water is defined as precipitation to land that does not runoff as wastewater or recharge the groundwater aquifer, but is stored in the soil or temporarily stays on top of the soil or in vegetation. This part of precipitation eventually evaporates from the soil or is transpired by the crop. The green water footprint includes this evapotranspiration and water incorporated into the harvested crop.

Indirect water usage related to agricultural raw materials will commonly include both blue water (irrigation from an aquifer or surface water) and green water (precipitation). Beverage companies often work with growers to focus on irrigation efficiencies (blue water reduction) and crop yield. From a water accounting perspective, the green water component may actually be a larger proportion of water usage and consumption in terms of evapotranspiration for those companies that use agricultural ingredients.

SABMiller has introduced a new term, net green water, to the water footprint calculations[5]. This term acknowledges that some form of vegetation was growing prior to the agricultural crop planted and grown for beverage raw material ingredients. The *WFN Manual* recommends calculating the total water consumed by the beverage crop, not the net difference between the current and baseline crop. This perspective document also recommends calculating total, not net consumption. The calculation of net green water introduces another element of inconsistency and complexity to a beverage water footprint. Companies that find value in this concept should be very transparent and explicitly state how and why they are using a net green approach.

Several beverage companies have invested in rainwater harvesting techniques as a way to reduce the need for aquifer or surface supplies of water. In the context of current definitions and for the purposes of this perspective, the storage of harvested rainwater for later use falls into the definition of blue water.

The *WFN Manual* defines the grey water footprint as "…*an indicator of freshwater pollution that can be associated with the production of a product over its full supply chain. It is defined as the volume of freshwater that is required to assimilate the load of pollutants based on natural background concentrations and existing ambient water quality standards. It is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards*". The wastewater generated and discharged as a result of the production of a beverage product is an important element in the determination of a water footprint. Due to the difficulty and inaccuracies associated with converting wastewater to a grey water footprint for addition to blue and green water, many beverage companies are calculating water

[5] Water Footprinting: Identifying and addressing water risks in the value chain; SAB Miller and World Wildlife Foundation; 2009.

footprints with and without a grey water volume component. These companies are effectively addressing wastewater impacts, risks and mitigation strategies outside of the calculation of a single water footprint value.

Suggested Approach

The generation and discharge of wastewater is an important impact that should be addressed when determining a beverage water footprint. As part of this sector perspective, it is recommended that the volume and quality of wastewater discharges be quantified. Wastewater is not viewed as a physical volume that can be effectively added to the green and blue water volume without adding even more complexity and inconsistency to a beverage water footprint. Wastewater will not be added to blue and green water to create a cumulative consumption in the examples shown in this document.

Beverage companies should be very transparent in reporting quantitative water footprinting results to distinguish between the inclusion or non-inclusion of wastewater. To avoid potential confusion throughout the rest of this document, the term wastewater will be used in examples as opposed to grey water.

Stormwater impacted by beverage industry activities is a qualitative impact that should be considered as part of the wastewater impact analysis. Completeness would also require consideration of liquid wastes and water contained in byproducts that are not discharged through the process sewer system. For example, water in thin and thick stillage that is hauled away from a beverage facility would be accounted for as wastewater.

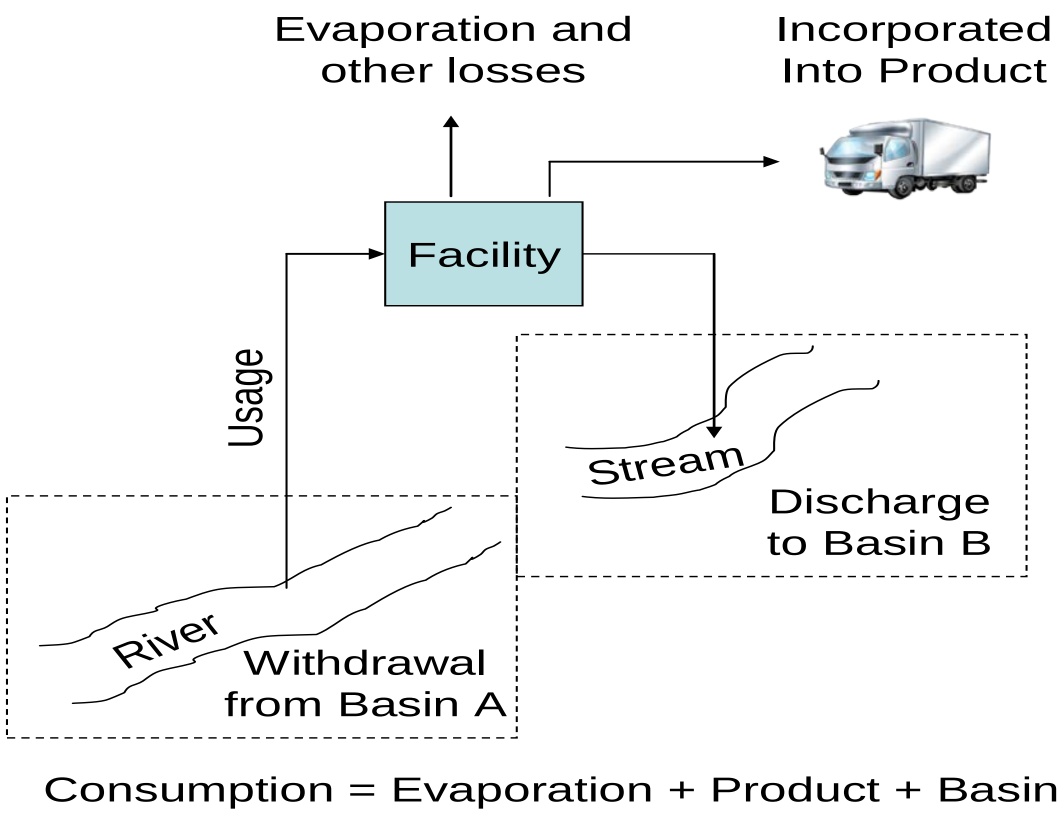
It is important for beverage companies to compile an inventory of wastewater discharge parameters (volume, quality, location, and timing) during the inventory step.

1.2 Water Usage and Consumption

Traditionally, water usage in the beverage industry has been quantified on a total volume or normalized volume (volume water used per volume product packaged). This ratio is typically well known and has become the standard for measuring water use efficiency in the beverage sector. Many beverage companies set internal and external reduction goals based on this normalized value. Numerous external reporting organizations request beverage data in the form of a total and normalized water usage at the manufacturing facility.

The term consumption has numerous definitions in water terminology. It refers to the amount of water “consumed”, not merely withdrawn for usage. The *WFN Manual* refers to the term consumptive water use in the following four scenarios:

1. Water that is evaporated;
2. Water that is incorporated into a product;
3. Water that is not returned to the same basin where it was withdrawn;
4. Water that is not returned during the same time period.



Beverage companies should first focus on establishing usage quantities for significant activities in the value chain. If incoming water and discharge wastewater volume data is available, the net difference typically is consumed through evaporation, losses or incorporation into the product. Water consumed due to timing or spatial aspects of the watershed basin is often more difficult to identify. Section 2.0, Determining Watershed Location and Size provides further perspective in this area.

<u>*Suggested Approach*</u>

For the purposes of this sector perspective, the WFN Manual definition of water consumption will be used. Beverage companies should inventory and communicate both water usage and water consumption in order to improve the transparency of communications related to this work.

2.0 Determining Watershed Location and Size

The term consumption includes water that is not returned to the same basin where it was withdrawn. This returned water is not immediately available for withdrawal and cannot be used by others in the basin. This accounting and timing of net water loss emphasizes the importance of defining the boundaries of the basin or watershed. Developing effective "local context" metrics for individual watersheds and communities is one of the six areas identified for improvement in the UNEP Report.

The level of detail necessary for watershed resolution will depend upon the intent of the water footprinting study. The purpose of this sector perspective is to assist beverage companies in the identification and screening of hotspots in local watersheds. As such, much of the discussion in this document will refer to smaller hydrologic units. Most of the data at this local level will be collected on an annual or monthly basis.

The importance of timing is reflected in new studies providing more granulated water data on a monthly versus an annual basis[6]. A more field specific hydrologic study could be completed at each point in the value chain to better understand the location and timing of water consumption. The cost and resources to conduct these studies may not justify the value they bring. For many bottled water companies, field specific hydrologic studies are critical to their business. As an initial screening exercise for most beverage companies to identify high priority watersheds, the use of established watershed delineations should be considered.

2.1 Global

At the macro level, the World Business Council for Sustainable Development (WBCSD) has created the Global Water Tool for companies and organizations to map their water use and assess risks relative to their global operations and supply chains. External datasets utilized to define watershed linkages include the Food and Agriculture Organization AQUASTAT, World Health Organization and UNICEF Joint Monitoring Program, University of New Hampshire Water Systems Analysis Group and the World Resources Institute for Watershed Data. The Global Water Tool does not provide specific perspective on local situations, which require more in-depth systematic analysis.

[6] Hoekstra, A.Y. and Mekonnen, M.M. (2011) Global water scarcity: monthly blue water footprint compared to blue water availability for the world's major river basins, Value of Water Research Report Series No. 53, UNESCO-IHE, Delft, the Netherlands.

HydroSHEDS (Hydrological data and maps based on Shuttle Elevation Derivatives at multiple Scales) provides hydrographic information in a consistent and comprehensive format for regional and global-scale applications. HydroSHEDS offers a suite of geo-referenced data sets (vector and raster), including stream networks, watershed boundaries, drainage directions, and ancillary data layers such as flow accumulations, distances, and river topology information.

The goal of developing HydroSHEDS was to generate key data layers to support regional and global watershed analyses, hydrological modeling, and freshwater conservation planning at a quality, resolution and extent that had previously been unachievable. HydroSHEDS has been developed by the Conservation Science Program of World Wildlife Fund (WWF), in partnership or collaboration with the U.S. Geological Survey (USGS); the International Centre for Tropical Agriculture (CIAT); The Nature Conservancy (TNC); the Government of Australia; McGill University, Montreal, Canada; and the Center for Environmental Systems Research (CESR) of the University of Kassel, Germany.

The International Union for Conservation of Nature (IUCN) has partnered with other organizations to create Watersheds of the World, an accessible river basin data that contains basin profiles for 154 basins and sub-basins around the world. Reliable data and information at the basin level are essential to manage water for people while sustaining functioning ecosystems, especially when dealing with international trans-boundary basins.

2.2 European Union

The European Union has established a common strategy for implementing Directive 2000/60/EC, referred to as the Water Framework Directive. The Directive requires Member States to sub-divide river basin districts into water bodies. However, surface waters include a large number of very small waters for which the administrative burden for the management of these waters may be enormous. The Directive does not include a threshold for very small “water bodies”. However, the Directive sets out two systems for differentiating water bodies into types, System A and System B. The smallest size range for a System A river type is 10 – 100 km2 catchment area. The smallest size range for a System A lake type is 0.5 – 1 km2 surface area. No sizes for small transitional and coastal waters are given. The application of system B should achieve, at least, the same level of differentiation as system A. It is therefore recommended to use the size of small rivers and lakes according to system A.

2.3 United States

The United States Geological Survey (USGS) has also created the concept of hydrologic units for watershed planning. The United States is divided and sub-divided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.

The first level of classification divides the United States into 21 major geographic areas, or regions. The second level of classification divides the 21 regions into 221 sub-regions. The third level of classification subdivides many of the sub-regions into accounting units. These 378 hydrologic accounting units are nested within, or can be equivalent to the sub-regions. Finally, the fourth level of classification is the cataloging unit, the smallest element in the hierarchy of hydrologic units. These units subdivide the sub-regions and accounting units into smaller areas. There are 2264 Cataloging Units in the United States.

Unfortunately, there is no one hydrologic cataloging system today that formally subdivides major global watersheds into smaller sub-region units that are representative of local issues.

Suggested Approach

Beverage companies should select the watershed basin size that is consistent with the intent of the study. For example, determining potential hot spots for business risk ranking and mitigation will require a smaller size hydrologic unit and time period to be considered. Generalizations about suppliers in one country versus another will allow for a larger hydrologic unit to be examined. Field specific hydrologic studies may be more appropriate for on-site beverage production wells.

Regardless, beverage companies should be very transparent as to the basin size and the timing of data used for each activity in the value chain.

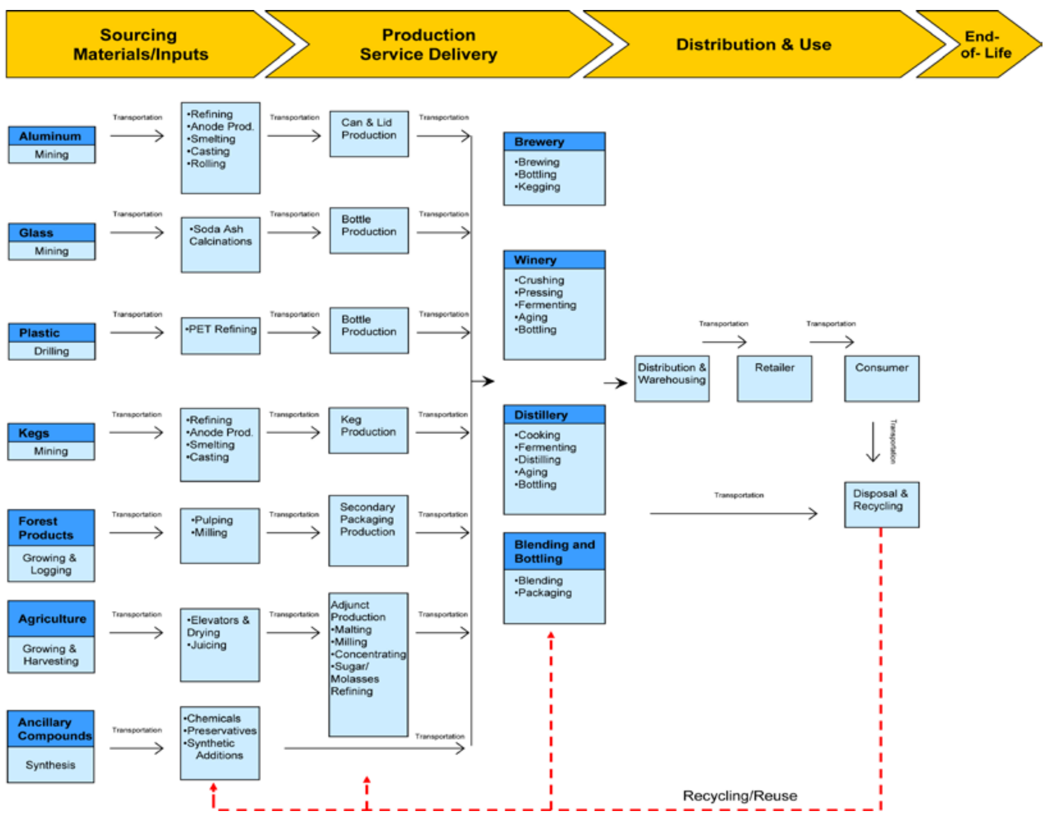
3.0 Quantifying the Water Inventory

3.1 Setting Boundaries

The WFN Manual details general methodology for quantifying the water inventory. Beverage companies are encouraged to reference this document. This section provides beverage company specific methodology and calculations to support the WFN Manual. A sample inventory log is provided as Appendix B which will help users tabulate information for summing beverage water usage and consumption and for subsequent sorting and prioritization for impact screening.

For the purposes of this sector perspective, the data presented will be on an annual average basis. As noted earlier, it may be more appropriate to gather monthly data depending upon the end-use of the analysis. Beverage companies with seasonal or variable production schedules should consider a monthly timeframe or shorter.

A beverage product water footprint encompasses all activities related to the generation, use, and disposal of the beverage and its associated packaging. It represents the combined water footprint of the beverage company, its suppliers and the consumer. The figure below highlights major activities within a beverage product water footprint.



Another way to look at the beverage product life cycle is by characterizing it into 6 major areas:

- ✓ **Beverage ingredients:** Includes water, agricultural and chemical components (preservatives and sweeteners)
- ✓ **Packaging materials:** Includes primary, secondary, and tertiary packaging
- ✓ **Beverage production and warehousing:** Includes distillation, brewing, bottling, blending, packaging, and finished goods warehousing. Also includes required chemical inputs for process and cleaning operations, such as ammonia, caustic, lubricants, etc.
- ✓ **Retail, marketing and consumption:** Includes the point-of-sale retailer, display cases, adware, refrigeration units, vending machines, restaurants, and end use by the consumer
- ✓ **Disposal, reuse and recycling:** Includes package components and waste streams generated throughout the life cycle
- ✓ **Transportation and distribution:** Includes all transportation of product through each stage of the value chain.

Co-packing and use of third-party vendors is a common practice and is reflected as part of the indirect water footprint. Co-packing operations are indirect when the reporting organization has no control over the production operation. For example, a beverage company may own and distribute a brand globally. However, in a specific location they contract with a third-party to manufacture or bottle the same product, without assuming direct control over the operations of that facility. The water footprint associated with the third-party owned and controlled entity would be accounted for as part of the indirect footprint. The same principles apply to joint-ventures over which the reporting organization does not have operational control.

De minimis Water Usage

For purposes of determining which activities within the beverage product life cycle should be included in the analysis, a volume threshold of 1% of total value chain water consumption is often suggested. Any individual material or activity that accounts for less than 1% of the total value chain water consumption is considered *de minimis*. Although this appears relatively straightforward, the large number of materials used by beverage companies and their suppliers makes determining a cut-off very difficult.

It would be necessary to complete preliminary calculations for all materials and activities to document exclusions under the 1% threshold. This sector perspective attempts to identify beverage related materials and activities that are likely to fall under a *de minimis* threshold and do not need further calculation for screening purposes. Beverage companies that intend to conduct a formal assessment, publish the results of this study or submit for third party review are encouraged to fully document all exclusions under the 1% threshold.

Suggested Approach

Conduct a multiple step analysis. Start at a high level by preparing an initial inventory and totaling the major water consumption activities in the beverage value chain. Any individual activity that accounts for less than 1% of the total value chain water consumption is considered de minimis.

3.2 Direct Water Usage and Consumption

The beverage production process will typically be accounted for as direct water usage and consumption. Table 1 summarizes the general categories of beverage industry direct water usage and consumption.

Table 1: Beverage Industry Direct Water Use and Consumption

General category	Water use and consumption
Incorporated into the beverage product	Water packaged as part of the final product leaving the facility is considered direct consumption.
Evaporated from the beverage facility	Water lost to evaporation at the beverage facility is considered direct consumption.
Wastewater discharged from the beverage facility	Wastewater water discharged to the same watershed basin from where it was withdrawn is considered used, but not consumed. Wastewater discharged to a different basin is considered consumed.
Overhead – Embedded water in physical assets	Embedded water in buildings, structures, equipment, office furniture, vehicles and other assets is considered *de minimis.*
Overhead – Landscaping	Beverage facilities may irrigate lawns and ornamental plants with an on-site well or may use third-party water. In some cases, wastewater is recycled for this purpose. Water evaporated during landscaping at the beverage facility is considered direct consumption.
Overhead – Once through and recycled cooling water	Water evaporated is considered direct consumption. Wastewater discharged to the same watershed basin from where it was withdrawn is considered used, but not consumed.

Primary water usage data should be available from on-site well log pumping records, third-party water provider billing statements or other direct measurements. This usage data can be converted to consumption based on definitions presented in Section 1.2 and illustrated below.

<u>Example 3-1:</u> A beverage manufacturing facility located in watershed "A" receives a third-party utility bill showing annual water usage of 180,000 m^3. The beverage company averages a water usage ratio of 3.0 m^3 / m^3 product. The third-party provider withdraws and treats surface water from watershed "A" for supply to the beverage company. The beverage company treats and discharges wastewater directly to a surface water in watershed "A".

The following calculations illustrate the annual direct water consumption of the beverage facility:

Total water usage = 180,000 m^3
Total water shipped in product (at 3.0 to 1.0 usage ratio) = 60,000 m^3
Total measured wastewater discharge = 110,000 m^3
Total water lost to evaporation = 180,000 – 60,000 – 110,000 = 10,000 m^3
Total water consumption = 60,000 + 10,000 = 70,000 m^3

Although total water usage is 180,000 m^3, only 70,000 m^3 is considered consumed.

The amount of water consumed will be different at a beverage company that receives water from one watershed and discharges to a different watershed.

<u>Example 3-2:</u> A beverage manufacturing facility located in watershed "A" pumps 180,000 m^3 of groundwater on-site from a well in watershed "A". The beverage company averages a water usage ratio of 3.0 m^3 / m^3 product.. The beverage company treats and discharges wastewater directly to a surface water in watershed "B".

The following calculations illustrate the annual direct water consumption of the beverage facility:

Total water usage = 180,000 m^3
Total water shipped in product (at 3.0 to 1.0 usage ratio) = 60,000 m^3
Total measured wastewater discharged = 110,000 m^3
Total water lost to evaporation = 180,000 – 60,000 – 110,000 = 10,000 m^3
Total water lost to a different watershed = 110,000 m^3

Total water consumption = 60,000 + 10,000 + 110,000 = 180,000 m^3

In this example, all water withdrawn from the aquifer is considered consumed.

Definition and Terms

BIER conducts an annual Water Stewardship Benchmarking[7] of report for its members. As part of this exercise, definitions regarding water usage are outlined to ensure consistency in collection. For the purpose of this water footprinting sector perspective, this same glossary of terms will be used in calculating direct water usage at the beverage company location. The glossary of terms is included as Appendix A.

Beverage facility definitions are also important to ensure consistency in calculating direct water usage. This perspective has adopted the definitions as outlined in the BIER Water Stewardship Benchmarking report.

> **Beverage Facility Definitions**
>
> *Bottling* – Locations where concentrate, syrup, flavors/infusions and/or bulk alcohol are blended with water and packaged into various container types. Facilities which received bulk finished product (such as completely brewed beer) for further packaging are also defined as bottling facilities. No fermenting or distilling processes are conducted at bottling facilities.
>
> *Brewery* – A facility conducting all processes after the malting process to produce beer. Process steps include milling, mashing/lautering, boiling, fermenting, aging and packaging.
>
> *Distillery* – A facility receiving milled grains and conducting the process to make bulk alcohol, and often to finished product. Process steps include cooking, fermenting, distilling and storage/maturing.
>
> *Winery* – Wineries include the crushing and pressing of grapes, fermentation, storage/aging and bottling. The winery total water use figures specifically exclude water used for irrigating crops.

Maturation Process

For some beverage alcohol products, including spirits, wines, and even beers, maturation is part of the beverage production process. Certain beverages, such as Scotch whisky, require years to fully mature before they are bottled for sale (maturation periods of over 10 years are common). During this time, the unfinished beverage is stored, usually in barrels, and virtually untouched, until the maturation period is complete and the material is bottled.

The maturation process has significant implications for product life cycle assessments, as certain steps in the product life cycle are completed many years before consumer use and end-of-life. Account for water usage and consumption associated with all processes up to the point of bottling, as they occur in the year in which the product's water footprint reporting occurs. For example, if a ten-year old Scotch whisky is bottled in 2008, water use relating to growing of cereals and to distilling in 2008 would be used in addition to those from bottling and distribution.

Another issue arising from the maturation process is that ethanol is lost to evaporation (commonly referred to as the "angel's share"). The final volume of product is less than the volume at the beginning of the maturation period. In lieu of primary data of loss percentages, apply an average

[7] Beverage Industry Environmental Roundtable, Water Stewardship Benchmarking, November 2009, Global Corporate Consultancy.

annual loss to evaporation for the product and apply this loss factor to the total water usage and consumption of the product up to and including distillation.

Beverage alcohol products may be blends from multiple producers (e.g. Blended Scotch whisky), multiple product types (e.g. a liquor that uses both a grain neutral spirit and a wine), or products that have matured for different periods of time (e.g. Kentucky bourbon). These additional layers of complexity demand even more transparency in water usage and consumption calculations and assumptions.

Cooling Water

Cooling water is often used by beverage facilities and may present some unique water consumption calculation challenges. The example below contrasts consumption of water from once-through versus recycled cooling water. In this example, the consumptive use associated with a recycled system is actually greater than a once-through system due to the higher evaporation rate associated with pumping and recycling water. The impacts and costs associated with once-through cooling water may justify a recycling system; however there may be cases where theoretically the actual water consumption could be greater with a recycled system.

Example 3-3: Beverage facilities 1 and 2 have equivalent daily cooling water needs. Beverage facility 1 uses 10,000 m^3 of once through non-contact cooling water. Beverage facility 2 uses 500 m^3 of cooling water as make-up to a recycled system. Both facilities discharge to the same watershed basin where they obtained the water.

The following calculations illustrate the direct water usage and consumption associated with cooling water in this example:

Facility 1:
Total water usage = 10,000 m^3
Total wastewater discharged = 9,900 m^3
Total water lost to evaporation or other = 10,000–9,900=100 m^3
Total water consumption = 100 m^3

Facility 2:
Total make-up water usage = 500 m^3
Total wastewater discharged = 300 m^3
Total water lost to evaporation or other = 500-300=200 m^3
Total water consumption = 200 m^3

Note: This does not include first time "filling" of the system. Depending upon the timing associated with the footprint, it may need to be included.

3.3 Indirect Water Usage and Consumption

The indirect or value chain water footprint includes all water used and consumed in the supply chain, such as agriculture or processing of ingredients. It also includes the distribution to consumers and eventual disposal of packaging materials. Table 2 summarizes the general categories of beverage industry indirect water usage and consumption. This indirect use by beverage facilities is a direct water use for the supplier or consumer.

Unlike the direct water footprint, beverage companies will likely have to seek additional data from their value chain or from published literature. Improving the collection of primary data from the supply chain at the watershed level is one of the six areas identified for improvement in the UNEP Report.

Obtaining primary data from suppliers is often difficult and time consuming, but is a critical task. Some form of non-disclosure agreement may need to be in-place in order to obtain relevant data. Attachment C provides an example letter that can be used to request primary water and wastewater data from suppliers. This is often a step that forces beverage companies to make general assumptions based on the lack of primary data.

Limited default data may be available through life cycle inventory sources, such as the Ecoinvent database[8]. The potential lack of primary data presents a major challenge for beverage companies that are looking to screen for watershed hot spots. The use of default data will weaken the effectiveness of the screening since water usage, consumption and impacts are so local and temporal in nature.

Table 2: Beverage Industry Indirect Water Use and Consumption

General category	Water use and consumption
Energy	Indirect water used and consumed to produce bio-fuels for energy generation at the beverage facility site should be calculated to determine significance. Indirect water used and consumed to produce fossil fuels for energy generation at the beverage facility site is suggested to be *de minimis*. Indirect water used and consumed to generate electricity for a beverage facility should be calculated to determine significance. This includes both renewable and non-renewable fuels, including hydro.

[8] Created in 1997, the ecoinvent Centre (originally called the Swiss Centre for Life Cycle Inventories) is a Competence Centre of the Swiss Federal Institute of Technology Zürich (ETH Zurich) and Lausanne (EPF Lausanne), the Paul Scherrer Institute (PSI), the Swiss Federal Laboratories for Materials Testing and Research (Empa), and the Swiss Federal Research Station Agroscope Reckenholz-Tänikon (ART).

General category	Water use and consumption
Beverage ingredients	Indirect water used and consumed to produce agricultural ingredients is a significant proportion of the water inventory for many beverages. Indirect water used and consumed to produce non-agricultural ingredients should be calculated to determine significance. Indirect water used and consumed to treat and deliver water to a beverage facility should be calculated to determine significance.
Packaging materials	Indirect water used and consumed to produce primary packaging materials is a significant proportion of the water inventory for many beverages. Indirect water used and consumed to produce secondary packaging materials should be calculated to determine significance.
Warehousing/ Distribution	Indirect water used and consumed during storage and delivery of beverage products is suggested to be *de minimis*.
Retail and Consumption	Indirect water used and consumed at a retail location is suggested to be *de minimis*. Indirect water used and consumed by the end consumer related to making ice to cool beverage products is suggested to be *de minimis*. Indirect water used and consumed by the end consumer to reconstitute beverage powders and concentrates is suggested to be *de minimis*.
Waste Disposal, Recycling and Reuse	Indirect water used and consumed during disposal, recycling and reuse of waste materials is suggested to be *de minimis*.

Some activities within Table 2 are suggested to be *de minimis*. Some of these suggestions are based on the collective knowledge of BIER members and others are based on published literature, such as described in "A Pilot in Corporate Water Footprint Accounting and Impact Assessment: The Water Footprint of a Sugar-Containing Carbonated Beverage"[9]. Calculations will be required for some activities that could potentially be significant for a beverage product. Caution should be exercised when eliminating an activity from further impact analysis based on the suggested *de minimis* threshold. Some activities may not be significant in total water volume used or consumed, but due to their significance in the supply chain could be susceptible to a water related business disruption risk that could impact a beverage company.

A more detailed discussion will follow for selected categories that may be a significant proportion of a beverage company's indirect water usage and consumption inventory.

[9] Ercin, A.E., Aldaya, M.M. and Hoekstra, A.Y. (2009) A pilot in corporate water footprint accounting and impact assessment: The water footprint of a sugar-containing carbonated beverage

3.3.1 Energy

As outlined in Table 2, indirect water used and consumed to produce bio-fuels for energy generation at the beverage facility site and for a third party to generate electricity for the beverage facility may be significant components of the water inventory.

On-site Bio-fuel Combustion

Beverage companies that use fuel crops (bio-fuels) for energy generation on-site should calculate the indirect water usage and consumption to determine significance.

A primary screening for significance can be made using published research. For example, Table 6a in the report "Water Footprint of Bio-Energy and Other Primary Energy Carriers"[10] provides water information for biomass. Primary data should always be used in lieu of published data. However, this initial screening is adequate to determine significance and prioritize inventory categories.

Beverage facilities that combust waste or spent products should not quantify the embedded water contained in these materials to avoid double counting of direct and indirect water usage and consumption.

Example 3-4: A beverage facility generates 10,000 GJ per year of energy on-site through combustion of bio-diesel in a cogeneration system. The bio-diesel is produced from soybeans grown in Brazil under non-irrigated conditions.

The following calculations provide a rough screening for significance:

Indirect water consumed = 61.1 m^3 / GJ (table 6a)
Total annual energy produced = 10,000 GJ
Total indirect water consumption = 10,000 x 61.1 = 611,000 m^3

Total Beverage Value Chain water consumption = 10 MM m^3

Bio-Energy water consumption % of total = 611,000 / 10MM = 6%

Bio-energy water consumption is greater than 1% and should be included in the water inventory.

[10] UNESCO-IHE, Gerbens-Leenes, P.W., Hoekstra, A.Y. and Van der Meer, Th.H. (2008) 'Water footprint of bio-energy and other primary energy carriers'

Third-Party Electricity Generation

Water usage and consumption in generation of electricity supplied to the beverage facility from third party entities may be significant.

A primary screening for significance can be made using published research. For example, Table S-1 in the report "Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production—The Next Half Century"[11] provides water withdrawal and consumption rates for common thermal power plant and cooling system types. Primary data should always be used in lieu of published data. However, this initial screening is adequate to determine significance and prioritize inventory categories.

Example 3-5: A beverage facility annually purchases 20,000 MWh of electricity from a third party coal-fired electric generation station that uses cooling towers.

The following calculations provide a rough screening for significance:

Indirect water consumed = 2 m^3 / MWh (table S-1)
Total energy purchased = 20,000 MWh
Total indirect water consumption = 20,000 x 2 = 40,000 m^3

Total Beverage Value Chain water consumption = 10 MM m^3

Electricity % of total = 40,000 / 10MM = 0.4%

The use of electricity at the beverage facility is less than 1% and meets the *de minimis* criteria.

3.3.2 Raw Materials

Beverage raw materials generally consist of water, chemicals, agricultural products and other ancillary compounds. This category, particularly agricultural ingredients, has been demonstrated to be a significant portion of the water inventory for many beverage companies.

[11] Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production—The Next Half Century, EPRI, Palo Alto, CA: 2002. 1006786.

Agricultural Ingredients

The majority of beverage companies rely on some form of agricultural product as a raw material input. The exceptions include treated, spring and mineral bottled water facilities. The water usage associated with growing agriculture crops has been identified as the largest contributor to a beverage company's water footprint (SABMiller, 2009[12], SABMiller 2010[13], The Coca Cola Company 2010[14]). It is often the most difficult to accurately quantify.

Given the importance of agricultural products to a beverage company's water footprint, the evaluation should extend all the way back to the actual growing of and harvesting of crops.

The most accurate calculation of an agricultural water footprint will include primary data obtained directly from the grower for a specific crop, including water usage, irrigation practices, crop yield, and rainwater data for each individual crop. However, in the absence of grower-provided data, averages for beverage industry crops in certain regions are available in published literature. The water footprint of more than two hundred derived crop products, including various flours, beverages, fibers and biofuels have been calculated in "The Green, Blue and Grey Water Footprint of Crops and Derived Crop Products"[15]. This reference provides data for crops and products at the state, province, and national level for nearly two hundred countries and territories.

Suggested Approach

Primary data should be obtained if possible. To quantify the agricultural water usage associated with a beverage product the following checklist should be utilized:

- ✓ *Create a list of crops used as input raw materials to the beverage product*
- ✓ *Determine the weight percentage of each crop in the beverage recipe*
- ✓ *Determine the geographic growing location (by specific watershed if possible) for each input crop*
- ✓ *Reach out to individual growers to get specific information on water usage, irrigation practices, crop yield, etc. for each identified crop*

[12] Water Footprinting: Identifying and addressing water risks in the value chain; SABMiller and World Wildlife Fund; 2009.
[13] Water Futures – Working Together for a Secure Water Future; SABMiller and World Wildlife Fund; 2010.
[14] Product Water Footprint Assessments, Practical Application in Corporate Water Stewardship; The Coca Cola Company and The Nature Conservancy; 2010.
[15] Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No. 47, UNESCO-IHE, Delft, the Netherlands.

Often agricultural crops are purchased from a co-operative that is comprised of hundreds of individual farmers. It would be extremely difficult or impossible to trace agricultural ingredients back to a specific farm. In these cases, the following estimation procedure is recommended.

Example 3-6: A beverage company purchases 1,000 tons of sugar beet from a farmer's cooperative in Spain. Sugar beet is purchased from 4 growing areas in Spain (Aragon, Madrid, La Rioja and Murcia) and combined at unknown percentages at a central location. Without further information, the indirect water consumption can be estimated using a straight arithmetic average.

Using the document "The green, blue and grey water footprint of crops and derived crop products", obtain default blue and green water consumption values from for each growing area.

Calculate the average water consumption (m3/ton) = (594+662+552+671)/4 = 620 m^3 /ton

Total indirect water consumption = 620 * 1,000 = 620,000 m^3

Although the approach above may allow an estimate of water consumption, use of default values severely limit the ability of a beverage company to identify local impacts, determine risks and opportunities and implement mitigation strategies.

Non-Agricultural Ingredients

Beverage companies use a variety of chemicals, such as flavorings, sweeteners, etc. as raw materials to the product. These raw materials are obtained from a wide variety of suppliers across the globe. Indirect water used and consumed to produce non-agricultural ingredients should be calculated to determine significance.

Suggested Approach

A second screening for significance is suggested for non-agricultural raw material ingredients. To avoid estimating the water consumption for potentially hundreds of deminimus materials, only those ingredients from first tier suppliers that represent more than 1% by weight of the final beverage product should be evaluated for significance.

A listing of all primary ingredients and their weight percentage in the final beverage product should be compiled to determine which ingredients are potentially significant for purposes of the water inventory. Each ingredient greater than 1% by weight should be evaluated for comparison to the *de minimis* level.

Example 3-7: A beverage company uses 10,000 kg of artificial sweetener X in its product. The sweetener is in the final product at 2.5 % by weight. Since the material represents more than 1% by weight of the final product, the indirect water consumption should be estimated for significance.

The supplier provides a water usage factor of 15 m^3 per kg of artificial sweetener X.

The following calculations provide a rough screening for significance:

Indirect water consumed = 15 m^3 / kg (conservative assumption of 100% water used is consumed)

Total indirect water consumption = 10,000 x 15 = 150,000 m^3

Total Beverage Value Chain water consumption = 10 MM m^3

Artificial Sweetener X % of total = 150,000 / 10MM = 1.5%

The use of Artificial Sweetener X at the beverage facility is greater than 1% and should be included in the water inventory.

Water - Transportation and Infrastructure

Water is the largest ingredient in most beverage products. A certain percentage of water will be evaporated and lost through leakage as water is pumped, transported, treated and eventually delivered to the manufacturing or agricultural location. These leakages may be significant for many third-party water providers. Many of these providers maintain good estimates of losses and have programs designed to minimize leakages and evaporation. Beverage companies are encouraged to contact their local water providers to better understand the infrastructure losses.

The majority of leaks may be to the same watershed and will not meet the definition of consumed. However, there may be significant evaporation during transport and storage. A further evaluation of this usage and consumption is recommended

Example 3-8: A beverage facility obtains 500,000 m^3 of water from a third-party provider. The third-party provider has documented treatment and distribution line losses of 30% by volume. Only 10% is through evaporation, the remainder stays within the watershed.

The following calculations provide a rough screening for significance:

Indirect water consumed =0.1 m^3 / m^3 (assumes 10% of losses are consumed)

Total indirect water consumption = 500,000 x 0.1 = 50,000 m^3

Total Beverage Value Chain water consumption = 10 MM m^3

Water Infrastructure Consumption % of total = 50,000 / 10MM = 0.5%

The infrastructure loss is less than 1% and meets the *de minimis* criteria.

Non-ingredient Raw Materials

Primary data for indirect water used and consumed from the manufacturing of other non-ingredient raw materials (i.e. sanitation chemicals) used at a beverage facility are generally very difficult to obtain. Many of these materials are purchased from a distributor that may obtain bulk chemicals from numerous suppliers and locations. The distributor typically does not have the traceability necessary to identify the exact location and timing of water used to produce the materials. Preliminary calculations estimate the water consumed from producing these materials to meet the *de minimis* criteria for beverages.

3.3.3 Packaging Materials

Types of packaging include primary (e.g. the container enclosing the liquid such as a bottle), secondary (e.g. a case of bottles/cans), and tertiary (a pallet of cases with shrink wrap that is prepared for transportation and storage). In certain sectors of the beverage industry, other packaging containers may be used for aging (e.g. barrels). Wooden barrels can be used one time or be used as “process” vessels where they are used for decades.

A variety of materials including plastic, glass, metals, and forest products are used for the different package types. Water is used and consumed with the production and use of each of these materials from their initial extraction from the earth or forest (incorporating recycled stock), through to the disposal, recycling, reuse and energy/materials recovery stages in the beverage product's life cycle.

The most accurate calculation of the packaging material water footprint will include primary data obtained directly from the supplier for a specific material, including blue and green water usage, origin of water (surface vs. groundwater), wastewater discharge, and watershed intake/discharge location and timing. However, in the absence of supplier-provided data, default estimates are discussed in the following sections based upon published data and information obtained through trade organizations. As discussed earlier, caution should be exercised when using default data that may compromise the effectiveness of the analysis.

Metal

Beverage companies' use of metal from primary packaging is dominated by the use of aluminum. The process for making aluminum involves mining bauxite (main element of aluminum), alumina production, anode production, the electrolysis for crude aluminum production, the imported component of electrolysis, and turning the aluminum into primary ingot casting. Once the aluminum sheet and ingot have been manufactured, the aluminum goes through a process of sheet rolling followed by can manufacturing to get its shape, body, lid, label, and inner liner to separate the beverage from the metal.

Typical can manufacturer's obtain their water from a third party for any water that is used within the plant (landscape irrigation water may come from wells located on-site). Most can manufacturing facilities are equipped with a wastewater treatment system designed to remove oil and grease and metals from the wastewater prior to discharge. The discharge of wastewater from the treatment system may be sent to a third party treatment works for additional treatment prior to discharge.

Water used in the production of 2-piece beverage cans is attributed to three (3) main categories:

1) *Process washers* - Proper cleaning and preparation of the formed can bodies is a critical step in can manufacturing. The quality of the final finish depends on the achievement of a proper cleaning that is compatible with the finishing process. The can washer uses multiple stages to thoroughly clean, rinse, and dry the cans. The process washers are the main driver of water usage in the plant and reductions have been achieved through recycling and reuse within the system.

2) *Support equipment* - The plant needs a number of support systems in order to operate properly. These would include a compressed air system, vacuum pumps, cooling towers and a

hot water system. The main source of water loss in these systems is through evaporation and blow down in the cooling towers.

3) *Wash down/clean-up* – The front end in a can plant uses a variety of oils and lubricants in the can forming process. Excess oil is washed into trenches that lead to an oil/water separation system and ultimately the wastewater treatment system.

The Aluminum Association recently completed a Cradle to Grave Life Cycle Assessment (LCA) for the manufacturing of aluminum beverage cans[16]. This study focused on the extraction of raw materials, energy and fuel inputs, further processing materials (e.g. chemicals, solvents, etc.), processing of raw materials and semi-finished products, transportation of raw and processed materials, and product recycling. The table below summarizes water and wastewater results.

Production Type 1 (kg)	List of Processes	Inputs (liter/kg)	Outputs (liter/kg)
Primary Alluminum Ingot	Bauxite Mining	2.94	2.78
	Alumina production	15.39	10.40
	Anode production	0.20	-
	Electrolysis process model for crude aluminum	9.10	11.94
	Imported component of electrolysis unit	7.29	2.63
	Primary ingot casating unit	0.10	-
Aluminum Can	Can sheet making (Body component)	1.31	2.03
	Can Sheet making (lid component)	0.42	1.06
	Can making	0.09	0.06
Secondary Ingot Casting	Remelting and Ingot casting	0.85	1.64

The following assumptions were made by PE America to conduct their LCA:

- 1,072 kg aluminum ingot per 1000 kg can sheet (body)
- 16.78 kg aluminum sheet for 1000 cans
- 23.31kg of aluminum ingot to 16.78 kg of aluminum sheet (1000 cans)
- 78:22 ratio can body to can lid
- Average weight of a 12 oz. can is 13.34 kg per 1000 cans
- Used beverage can recycling rate in 2006 was 51.6%
- The recycled content of beverage cans in US in 2007 was 67.8%

The table below summarizes water consumed, likely from evaporation, for a can body and lid.

Components Two Piece Can	Water Use (liters/kg)	Waste Water (liters/kg)	Difference (liters/kg)
Can Body	38.36	32.07	6.29
Can Lid	10.82	9.05	1.77
Total Can (Body & Lid)	**49.18**	**41.12**	**8.06**

[16] Life Cycle Impact Assessment of Aluminum Beverage Cans; PE Americas; May 21, 2010

Example 3-9: A facility uses 100,000 kg of aluminum can bodies to package beverages.

The following calculations provide a rough estimate of water consumption by the aluminum can body and lid suppliers:

Indirect Water Usage = 100,000*49.18/1000 = 4,918 m^3
Indirect Wastewater Discharge = 100,000*41.12/1000 = 4,112 m^3

Indirect Water Consumption = 4,918 – 4,112 = 806 m^3

As stated throughout this document, the use of default information will allow the creation of a number with limited value. The use of supplier primary data is critical.

Glass

Beverage companies' use of glass for primary packaging is split into returnable and non-returnable containers. This market is dominated in the United States by non-returnable containers. In the rest of the world, returnable containers are more prevalent. These materials are obtained from a wide variety of suppliers across the globe.

The most common raw materials used to produce glass are cullet (post-consumer recycled glass), silica sand, soda ash (reduces melting temperature), limestone (enhances durability of glass), and other materials can be added to produce different colors. Container glass is made by melting together several largely naturally occurring minerals.

The most significant water use at the glass plant occurs during cooling and cullet cleaning. Wastewater discharge will contain contact cooling water system purges and cleaning waters. Stormwater discharge contamination is possible from outdoor storage of cullet. Closed-water process systems are in place at most modern manufacturing facilities to minimize losses. Wastewater discharged from the manufacturing of container glass are marginal in comparison with other industrial sectors and are limited to particular processes (e.g. hot gob quenching and water-cooled shears)[17]. In fact, some facilities have installed systems to reclaim the water used in the shearing and cooling process and have approached a facility with zero discharge other than domestic sewage from employee restrooms

[17] IFC Environmental, Health and Safety Guidelines – Glass Manufacturing April 30, 2007

and eating facilities. Wastewater discharges may be affected by glass solids, some soluble glass-making materials (e.g. sodium sulfate), some organic compounds caused by lubricant oil used in the cutting process, and treatment chemicals (e.g. dissolved salts and water treatment chemicals) for the cooling-water system.

The European Container Glass Federation "FEVE"[18] conducted a cradle to cradle LCA on packaging glass. The system boundaries includes batch material, processing of materials, post-consumer cullet treatment, melting, production of energy, operation of primary production equipment, transport of batch materials, internal transportation of batch materials, and non-melting (heating, lighting, forming, finishing, etc.) of manufacturing facilities. It also includes the use and end use of the product which entails: transportation, washing and (if applicable) sterilization, reuse of glass container (transportation as well as washing and sterilization), recycling, landfill, and incineration (of inert matter), and the use of cullet from non-container glass (e.g. flat glass). The process for the lid/cap of the bottle was not included in this study but has been captured in this section of the report.

Glass is a material that can be recycled continuously. Due to the high rates of recycling glass and using recycled glass in the manufacturing of bottles, there are no studies available that assess the water use from glass bottles without the component of recycling already incorporated into the data. The FEVE study includes the burden and credit associated with the upstream processing and production of materials and energies that make up the production of the stated functional unit. Transport of materials to container glass production sites, production of container glass, transport to warehouses and customers, and end-of-life disposal / recycling are also included in this study. To account for the credit associated with the recycling of cullet from end-of-life, the current European average recycling rate is estimated to be 54 % and no reuse is considered.

Steel is the most common material used to manufacture the lid of a bottle. The World Steel Association conducted a Cradle to Gate (including Recycling) LCA on Steel Products[19]. This study was used to account for the water use associated with bottle cap component of the bottle. While this study covers steel manufacturing, it is not specific to the bottle cap process. No significant data on wastewater is provided in this study.

Component of Glass Bottle and Steel Cap	Water Use (liters/kg)	Wastewater (liters/kg)	Difference (liters/kg)
Container Glass	3.56	3.31	0.25
Steel Cap	1.51	1.26*	0.25
Total Container	**5.07**	**4.57**	**0.50**

* Estimated using wastewater-water ratio of 0.836 for aluminum lid

The water usage and consumption associated with cleaning returnable glass bottles at the beverage facility should be included in the beverage facility direct water use and consumption.

18 Life Cycle Assessment of Container Glass in Europe, A Report by European Container Glass Federation (FEVE)- July 2010
19 The World Steel Association, LCI Data For Steel Products May 2011

Example 3-10: A facility uses 100,000 kg of glass bottles to package beverages.

The following calculations provide a rough estimate of water consumption by the glass bottle and steel cap suppliers:

Indirect Water Usage = 100,000*5.07/1000 = 507 m^3
Indirect Wastewater Discharge = 100,000*4.57/1000 = 457 m^3

Indirect Water Consumption = 507 – 457 = 50 m^3

As stated throughout this document, the use of default information will allow the creation of a number with limited value. The use of supplier primary data is critical.

Plastics

Beverage companies' use of plastics for primary packaging is dominated by the use of polyethylene terephthalate (PET). This material is obtained from a wide variety of suppliers across the globe. This section will also include the blow molding process associated with shaping the bottle.

PlasticsEurope conducted a cradle to gate LCA on PET resin. This section describes the production of 1 kg of Polyethylene Terephthalate (PET, bottle-grade) polymer from cradle to gate (the extraction of crude oil to resin or granules at the manufacturing plant). This process did not include the cap, or actual process to create a bottle from the PET resin.

The most significant processes associated with PET resin are aromatic separation (In the U.S. and Europe this process includes reformate which is the main source of xylenes, ethylene and ethylene glycol production), oil refining (the naphtha and reformate production take place within the refinery), grid electricity, and transport. This study does not include the production of PET from secondary material (PET waste) and imported PET to Europe is not considered in this eco-profile. According to PlasticsEurope it takes 60 grams of water (53 g of processed water and 7 grams of cooling water) to produce 1 kg of PET bottle grade resin. There was no information on the waste water associated with the production of 1kg of PET polymer.

The majority of plastic bottles are formed from the PET resin in the blow molding process. The system boundary includes the transport of the resin material to the conversion factory (including the production of fuel required for the transport), the conversion process itself including the production of fuels for energy use at the factory, and finally the packaging used for the dispatch of end products. According to an LCA on blow molding by PlasticsEurope[20] it takes an additional 40 liters of water to produce 1 kg PET bottle using the blow molding process.

Note: The cited study included a large water use component attributable to extensive hydropower use for electricity generation. In order to maintain consistency with the other packaging studies the water used from the turbine use process is not included.

The last component of a plastic container is the lid. Unlike the body of the bottle that uses PET, the cap is generally made out of HDPE. According to PlasticsEurope, it takes 29 kg of water to produce 1kg of HDPE pipe. The process for making a pipe out of HDPE is similar to the process of making a cap. The processes included are the transport of the resin material to the conversion factory (including the production of the fuel required for the transport), the conversion process itself including the production of fuels for energy use at the factory, and finally the packaging used for the dispatch of the end product.

The full cradle to gate PET bottle includes the production of PET, the blow molding, and the cap made of HDPE.

Component of PET Bottle and HDPE Cap	Water Use (liters/kg)	Wastewater* (liters/kg)	Difference (liters/kg)
PET Resin	60.00	52.20	7.80
Blow Molding	40.00	34.80	5.20
HDPE Cap	29.00	25.23	3.77
Total Container	**129.00**	**112.23**	**16.77**

* Estimated using wastewater-water ratio of 0.87 (average of glass and aluminum containers)

<u>Example 3-11</u>: A facility uses 100,000 kg of plastic bottles to package beverages.

The following calculations provide a rough estimate of water consumption by the plastic bottle and cap suppliers:

Indirect Water Usage = 100,000*129/1000 = 12,900 m^3
Indirect Wastewater Discharge = 100,000*112.23/1000 = 11,223 m^3

Indirect Water Consumption = 12,900 – 11,223 = 1,677 m^3

The consumption of water in the manufacturing of polymer labels is assumed to be below 1% of total water consumption and can be considered *de minimis* for purposes of this analysis.

[20] PET Injection Stretch Blow Molding- PlasticsEurope February 2010

Forest Products

Beverage companies use a variety of forest products (paper, cardboard and wood) for secondary packaging. These materials are obtained from a wide variety of suppliers across the globe.

A primary screening for significance can be made using published research. For example, Table 9 in the report "*The green and blue water footprint of paper products*"[21] provides water factors for paperboard produced in several countries and for varying wood types. Primary data should always be used in lieu of published data. However, this initial screening is adequate to determine significance and prioritize inventory categories.

> Example 3-12: A beverage facility purchases 1,000 tons of paperboard from a manufacturer in China for use as secondary packaging. The manufacturer documents the source of wood as pine from temperate biome.
>
> The following calculations provide a rough screening for significance:
>
> Indirect water consumed = 2,124 m3/ ton paperboard (per table 9)
>
> Total indirect water consumption = 1,000 x 2,124 = 2,124,000 m^3
>
> Total Beverage Value Chain water consumption = 10 MM m^3
>
> Secondary Packaging Consumption % of total = 2.1MM / 10MM = 21%
>
> Secondary Packaging is greater than 1% and should be included in the water inventory.

Wooden barrels are used by some beverage companies for primary packaging of product or as a process step for aging and storage. Primary supplier data should be requested since little published data is available. An additional complicating factor is the lifespan of the barrel. In theory, the water usage and consumption could be allocated over the identified lifespan. However, not every barrel makes it to the full life span. Performing calculations that allocate water over an average 50 year life of a barrel brings questionable value since watershed impacts are so spatial

[21] Van Oel, P.R. and Hoekstra, A.Y. (2010) The green and blue water footprint of paper products: methodological considerations and quantification.

and timing dependent introduces additional estimation errors that are questionable not useful in determining specific watershed impacts.

Indirect water used and consumed from the manufacturing of wooden barrels used at a beverage facility is considered *de minimis*.

3.3.4 Warehousing

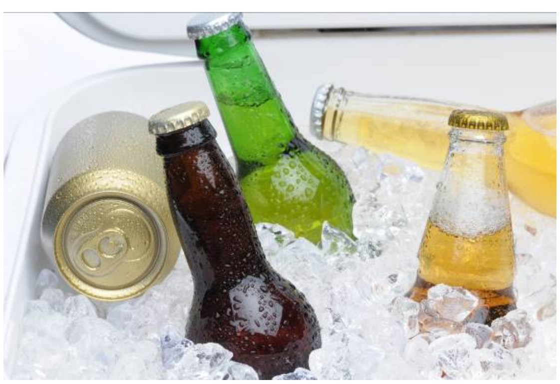
Small amounts of water are used during the warehousing and storage of finished product prior to distribution to retail accounts. This includes water usage to support employees, washing of vehicles, general cleaning and landscape irrigation. A high percentage of this water usage would not be consumed, but rather returned to the watershed through wastewater discharges.

The usage and consumption of water during this phase is considered *de minimis.*

3.3.5 Retail and Consumption

Water is used and consumed during the retail sale phase of the product life cycle as well as during the beverage end use by consumers. For example, there is overhead water usage at both on and off-premise retail establishments for restrooms, kitchens, cleaning glassware, cleaning draught lines, etc.

In addition, many beverage products are served with ice or ice is used in coolers to lower the temperature of the product. The use of ice by a consumer is often a personal preference.



Consumer use could also include reconstitution of beverage powders and concentrates. This would typically be allocated to the consumer water footprint. In most cases, evaporation should be minimal and consumers are likely to withdraw and discharge water to the same catchment basin.

The usage and consumption of water in the retail and consumption phase is considered *de minimis.*

3.3.6 Waste Disposal, Recycling and Reuse

Water is used during the waste disposal, recycling and reuse phase across the entire value chain, including recycling of primary and secondary packaging materials and spent agricultural crops. Overhead water usage is associated with employee demand, general cleaning and landscape irrigation.

The usage and consumption of water in the waste disposal, recycling and reuse phase is considered *de minimis.*

3.3.7 Transportation

Transportation of beverage products occurs across the entire value chain, including delivery of raw materials and supplies to the company; between company units; and distribution of product to the consumer. Common forms of transport used in the beverage life cycle include locomotives, passenger vehicles, trucks, planes, and cargo ships and barges.

The water embedded in the transportation infrastructure is considered *de minimis* and is not included in a beverage water footprint. In addition, water usage associated with washing vehicles and supply chain water usage associated with production of transportation fuels is considered *de minimis*.

3.4 Water Inventory

Direct and indirect usage and consumption of water, wastewater and watershed locations can be compiled into a water inventory for further sorting and analysis. Using the sample inventory log in Appendix B, a volumetric total can be logged and tabulated for key parameters. In example 3-13, total water usage across the value chain is estimated at 180.5 and the total water consumption is estimated at 147.0 liters water used per liter beverage product packaged. Activities with the highest contribution to the totals can be identified and sorted. It may also be useful to sort on withdrawal or discharge watershed location to understand where the volumetric use, consumption and discharge parameters are the greatest.

Example 3-13: Beverage facility Z completes a water inventory using Appendix B and normalizes data per liter of finished product packaged.

Category	Activity	Withdrawal Watershed	Water Usage (liter/liter)		Water Consumed (liter/liter)		Wastewater Discharge (liter/liter)	Discharge Watershed
			Blue	Green	Blue	Green		
Direct	Incorporated into Product	#100	1.0	0	1.0	0	0	#100
	Process & Overhead	#100	3.0	0	0.5	0	2.5	#100
	Landscaping	#100	*de minimis*					
Indirect	Energy – On-Site Biofuels	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Energy – 3rd Party Electricity	#200	20.0	0	0.5	0	19.5	#200
	Ingredient A	#300	10.0	130.0	2.0	130.0	8.0	#300
	Ingredient B	#400	2.0	0	2.0	0	2.0	#500
	Ingredient - Water	#100	*de minimis*					
	Primary Packaging A	#600	1.5	0	0.5	0	1.0	#600
	Secondary Packaging A	#700	1.0	10.0	0.5	10.0	0.5	#700
	TOTALS		40.5	140.0	7.0	140.0	33.5	

These summations are often useful to compare volumetric water usage across beverage products or facilities. As was discussed in Section 1.0, the volumetric totals by themselves are of limited value, since water has such spatial and timing implications.

4.0 Data Reporting

This section outlines the data reporting requirements applicable to any company seeking to publicly claim adherence to this Sector Perspective.

4.1 Data Transparency

As the intention of this Sector Perspective is to achieve a common methodology for the beverage industry to account for and report water usage and consumption, it is critical that companies are transparent in their reporting. Transparency includes describing any exceptions to this perspective and where primary and default data were used.

4.2 Alignment with Sector Perspective

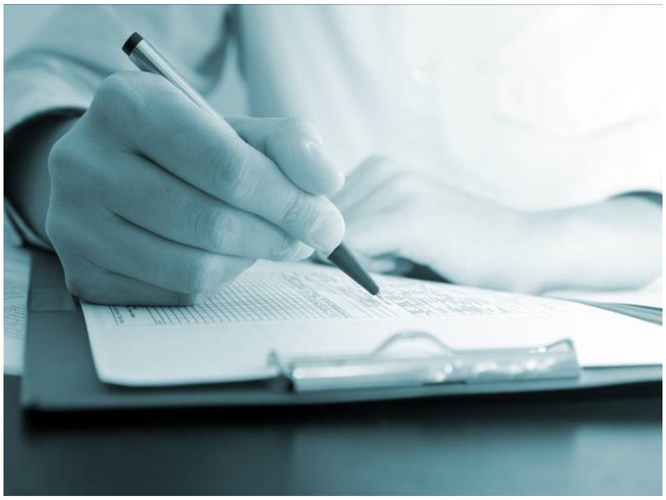
Any beverage company electing to publicly report a water footprint in accordance with this Sector Perspective document should clearly state this in its report. Clearly document and explain each deviation from this perspective.

4.3 Data Source Limitations

The user should clearly list any data limitations and state reasons for excluding these data points in the report.

4.4 Data Verification

This Sector Perspective suggests several methods of obtaining water usage and consumption data. Primary and default data sources should be clearly identified.



Unlike carbon footprinting, outside verification is not routinely conducted for water footprinting. While verification by a third party may increase the credibility of publicly reported water footprint estimate, this field is not well defined and there are no clear standards for verification at this time. This sector perspective does not require nor endorse third-party verification.

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Contact Information

Should you have any questions related to this report, feel free to contact: info@bieroundtable.com

Appendix A – Glossary of Terms

TERM	UNITS	DEFINITION
Beverage Product Mix	%	A description of all Beverage Production Shares across a Company or individual facility. The sum of Beverage Production Shares across an entity should equal 100%.
Beverage Product Share	%	A volume share measure defined as Specific Beverage Production/Total Beverage Production. If necessary to estimate on a facility specific basis, estimate to + or - 5%.
Bottled Water, Mineral	N/A	Bottled water containing not less than 250 parts per million total dissolved solids may be labeled as mineral water. Mineral water is distinguished from other types of bottled water by its constant level and relative proportions of mineral and trace elements at the point of emergence from the source. No minerals can be added to this product.[1]
Bottled Water, Natural	N/A	All bottled waters other than mineral and spring water. Includes purified water (produced by distillation, deionization, reverse osmosis, or other processes), sparkling bottled water, or well water.
Bottled Water, Spring	N/A	Bottled water derived from an underground formation from which water flows naturally to the surface of the earth. Spring water must be collected only at the spring or through a borehole tapping the underground formation feeding the spring.[1]
Bottling Facility	N/A	Locations where concentrate, syrup, flavors/infusions, and/or bulk alcohol are blended with water and packaged into various container types. Facilities which received bulk finished product (such as completely brewed beer) for further packaging are also defined as bottling facilities. No fermenting or distilling processes are conducted at bottling facilities. This category encompasses all eleven beverage types defined in the benchmarking study.
Brewery	N/A	A facility conducting all processes after the malting process to produce beer. Process steps included within the scope of the study include milling, mashing/lautering, boiling, fermenting, aging, and packaging.
Carbonated Soft Drink (CSD)	N/A	A non-alcoholic, flavored, carbonated beverage. Includes colas, ginger ales, seltzers, etc.
Distilled Spirits	N/A	An alcoholic beverage made by distillation rather than fermentation.
Distilled Spirits, High-Proof	N/A	Any distilled spirit with an alcohol content 20% or higher. Includes gin, vodka, tequila, whisk(e)ys, etc.
Distilled Spirits, Low-Proof	N/A	Any distilled spirit containing less than 20% alcohol. Includes ready-mixed drinks, wine coolers, etc.
Distillery	N/A	A facility receiving milled grains and conducting the process to make bulk alcohol, and often to finished product. Process steps included in the scope of a distillery were cooking, fermenting, distilling, and storage/maturing.
Enterprise	N/A	An enterprise includes all beverage-related activities for the BIER reporting company. This will include but not be limited to: all manufacturing operations, offices, research facilities and transportation activity.

TERM	UNITS	DEFINITION
Facility/Factory	N/A	A facility or factory encompasses a single campus and may include multiple buildings. Examples of facilities include sales offices and research centers, while factories are typically manufacturing plants. This term applies to all on-site activities on the campus (fleet, equipment maintenance, etc.) unless such activities are expressly excluded and reported separately.
Hotel Load	N/A	The non-manufacturing and warehouse portion of any plant. Includes the bathrooms and office space of a facility.
Life Cycle	N/A	The assessment of the environmental impacts of a given product or service throughout its lifespan, including all phases: raw material production, manufacture, distribution, product use and disposal and all intervening transportation steps.
Non-Carbonated Beverage (NCB)	N/A	A non-alcoholic, flavored beverage. NCBs include ready-to-drink (RTD) teas and coffees, fitness drinks, energy drinks, and juice drinks (either from concentrate or less than 100% pure juice).
Non-Underground Water	N/A	Water taken from all sources which do not meet the definition of Underground Water. Includes surface and municipal supply sources.
Product	N/A	A standard base sales unit not differentiated by volume (both package and product) (e.g. bottle of soda, can of beer, PET of juice, box of wine). A product is a subset of the beverage class; for example, carbonated soft drink, fitness drink, juice, beer, wine, distilled spirits, or water.
Return Water	N/A	Underground water returned to the aquifer, the aquifer recharge area or natural drainage basin without significant modification (based on environmental impact evaluated by a hydrogeologist). Water released during validation of source (pumping tests and water process setup) is included as Return Water. Water released during validation can only be included as return water for a maximum of 12 months.
SKU	N/A	An SKU (stock keeping unit) is a sales unit as defined by reporting organization; for example, a 12-oz can of carbonated soft drink or a 750 ml bottle of wine.
Specific Beverage Production	Liters	The total volume water contained within the finished product of a Specific Beverage Product.
Specific Beverage Products	N/A	For the purposes of this benchmarking project beverage products will be broken-out and distinguished into the following categories: Beer, Bottled Water - Mineral, Bottled Water - Natural, Bottled Water - Spring, Carbonated Soft Drinks, Distilled Spirits - High Proof, Distilled Spirits - Low Proof, Juice - 100%, Non-Carbonated Beverages, Wine, and Other.
Total Beverage Production	Liters	The volume of finished product generated at a facility or by a company. For facilities that produce alcoholic beverages, total beverage production should represent the actual volume of product (wine gallons), and should not be scaled to a specific alcohol content.

APPENDIX A

TERM	UNITS	DEFINITION
Total Wastewater Generated	Liters	The total volume of water effluents from the facility outfall discharged to any of the following locations: deep well, seepage ponds/lagoons, sanitary sewer, storm sewer, surface water, or waste haul. Reported wastewater volume data is available by one of three data sources: **metered**, if there is a flow-through meter on the facility outfall; **calculated**, if the discharge volume is determined based on a water balance with other plant uses (i.e. all water not accounted for by cooling tower meters or beverage production is assumed to be discharged), or **theoretical**, if a simplified mass balance is used.
Total Water Usage	Liters	All water used by the plant (including Bottling and Industrial Water) from all sources used for activities including but not limited to: beverage production, cleaning/sanitizing processes, cooling waters, sanitation, landscaping, etc. Total Water Usage includes stormwater/rainwater captured for activities defined above. Total Water Usage excludes Return Water as defined here.
Underground Water	N/A	Water taken from a natural free-flowing spring, borehole, well, or other extract from an aquifer under the management of the beverage company.
Value Chain	N/A	The network along which products or services move from suppliers to customers, transporting raw materials and transforming them in to a finished project, delivering finished product to end users, and disposal or recycling of residual wastes. A value chain may consist of many different suppliers and customers before the product reaches the end user.
Water Use Ratio	Liters/Liters	A measure of efficiency defined on a Facility Specific or Company-Wide basis as Total Water Usage / Total Beverage Production.
Winery	N/A	A facility conducting the crushing and pressing of grapes, fermentation, storage/aging, and bottling processes to produce wine. The winery total water use figures specifically exclude water used for irrigating crops.

1 - International Bottled Water Association (http://www.bottledwater.org/public/faqs.htm)

Appendix B – Sample Inventory Log

Category	Activity	Withdrawal Watershed*	Water Usage (m3)		Water Consumed (m3)		Wastewater Discharge (m3)	Discharge Watershed*
			Blue	Green	Blue	Green		
Direct	Incorporated into Product							
	Process & Overhead							
	Landscaping							
Indirect	Energy – On-Site Biofuels							
	Energy – On-Site Fossil Fuels							
	Energy – 3rd Party Electricity							
	Ingredient A							
	Ingredient B							
	Ingredient C							
	Ingredient D							
	Ingredient - Water							
	Primary Packaging A							
	Primary Packaging B							
	Primary Packaging C							
	Primary Packaging D							
	Secondary Packaging A							
	Secondary Packaging B							
	Secondary Packaging C							
	Secondary Packaging D							
	Consumer - Reconstitution							

* Distinguish between surface and groundwater

Appendix C – Supplier Data Request Sample Correspondence

[SUPPLIER NAME]
[SUPPLIER ADDRESS OR E-MAIL]

Re: Water Footprint Data Request

Dear Supplier Partner -

[BEVERAGE COMPANY NAME] is conducting a water footprint assessment of our products. We are doing this to better understand our products' impacts upon the environment, as well as to identify potential water related business risks and opportunities throughout our supply chain. As a trusted partner, we are asking for your participation in a short survey. The success of this project is heavily dependent upon your input of primary data. We understand the confidential nature of these data and will treat them as such.

The attached survey requests production and water/energy related data for calendar year [YEAR]. Please complete and return to my attention by [DATE].

We appreciate your assistance in gathering this data and would be happy to share it with you when the study is completed. Please call me at [PHONE] with any questions or concerns.

Sincerely,

[NAME/TITLE]

Appendix C – Supplier Data Request Sample Input Form

1. Company name:	*Name of entity.*
2. Manufacturing location address:	*City, State, Country.*
3. Person completing this form:	*Name and phone number, in case clarification is needed.*
4. Title:	*Title of person completing form.*

1. Total Production (units):	*Total production of all units at the facility.*
2. Specific Production (units):	*Production of identified units that are supplied to [BEVERAGE COMPANY NAME] or identified units that are supplied to all customers.*

1. Primary water supplier name and location:	*Name of municipal or private water supplier and location (City, State) or state on-site wells.*
2. Total water usage (gals):	*Amount from utility bill or from internal well pumping records.*
3. Secondary water supplier name and location (if applicable):	*Name of municipal or private water supplier and location (City, State) or state on-site wells.*
4. Total water usage (gals):	*Amount from utility bill or from internal well pumping records.*

1. Total wastewater discharge volume (gals):	*Amount from utility bill or from internal monitoring records.*
2. Describe any on-site treatment:	*Brief description (none, screens/neutralization, clarifier, anaerobic, aerobic, etc.).*
3. Final wastewater treatment plant name and location:	*Name of municipal or private wastewater treatment provider and location (City, State).*
4. If direct discharge, receiving water body name:	*If wastewater is discharged without further municipal or private, state name of receiving water body.*

1. Primary electrical provider name and location:	*Name of municipal or private electrical provider and location (City, State).*
2. Total electricity usage (kwh):	*Amount from utility bill or from internal records if on-site cogeneration is used.*
3. Primary natural gas provider name and location:	*Name of municipal or private natural gas provider and location (City, State).*
4. Total natural gas usage (therms):	*Amount from utility bill or from internal records if on-site bio-gas generation is used.*

1. Primary supplier name and location:	*Name of raw material supplier and location (City, State).*
2. Primary supplier name and location:	*Name of raw material supplier and location (City, State).*
Note: If these suppliers do not represent >90% of raw material inputs by weight, please list additional primary suppliers below.	*Please list your major suppliers of raw materials that provide over 90% by weight of all inputs to your product.*
Other raw material - Primary supplier name and location:	*Use this to list additional raw materials, supplier names and locations.*