TECHNICAL GUIDANCE

STEP
3
MEASURE, SET & DISCLOSE

FRESHWATER

SCIENCE BASED TARGETS NETWORK
GLOBAL COMMONS ALLIANCE

Credits & Acknowledgments

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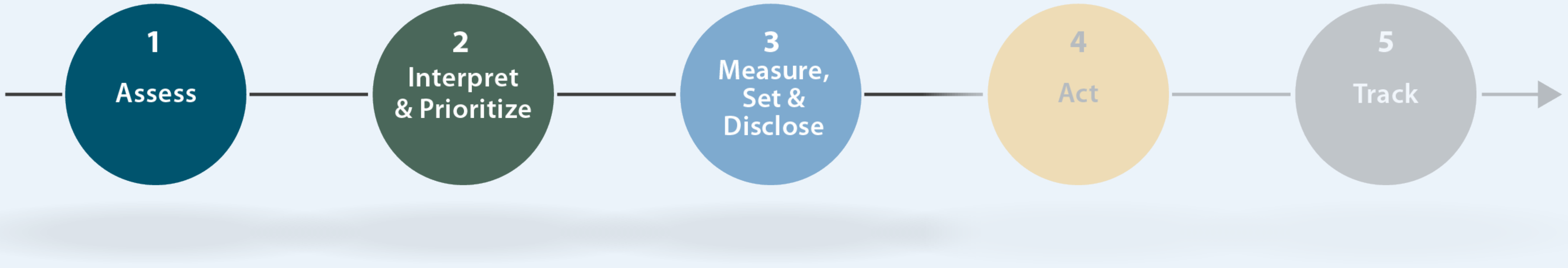

The five-step process for setting science-based targets for nature.

Letter from SBTN's Technical Director

> *By taking enough of the right actions, in the right places, and at the right time through science-based targets, companies can contribute towards an environmentally safe and socially just future.*

Dear Reader,

The first release of science-based targets for nature marks a critical step forward for the Science Based Targets Network (SBTN) and for corporate action on the mounting environmental and social crises associated with nature and biodiversity loss.

SBTN is a unique collaboration of over 80 leading global non-profits and mission-driven organizations, working together to co-develop and test scientifically rigorous and actionable methodologies for setting science-based targets (SBTs). To complement existing science-based targets for climate through the Science Based Targets initiative, SBTN is developing science-based targets for nature.

With the release of the first science-based targets for nature in 2023, SBTN is making available a robust and integrated methodology that offers companies the methods, guidance and tools they need to set validatable targets to directly address their pressures on freshwater, land and biodiversity today. Future releases of methods from SBTN will increase coverage of corporate impacts.

SBTN, is by design, more detailed and prescriptive than other frameworks in the sustainability space, providing step-by-step guidance at each stage of the process. The purpose of our guidance is to empower companies to deploy a clear, analytical approach, tested and vetted by scientific experts, for assessing and addressing their environmental impacts. For this reason, the methodology builds on existing frameworks, data, and tools to increase efficiency for companies with more sustainability experience. It also aims to create a pathway for companies who are ealier on their sustainability journey, by providing tools, data and models to facilitate target-setting.

While applying these methods, it is important to note that SBTN methods will improve and increase in scope with advancements in science and technology, and through the application of our methods by companies. Subsequent releases will include greater coverage of biodiversity, marine impacts, and additional sources of freshwater pollution, to name a few areas of current development. Additional planned content includes guidance on Step 4: Act and Step 5: Track with validatable metrics associated with the Stakeholder Engagement Guidance.

With this novel release of science-based targets for nature, we aim to ensure that companies take measurable step towards assessing, mitigating, and managing their impacts on nature and society. By taking enough of the right actions, in the right placees, and at the right time through science-based tarets, companies can contributed towards an environmentally safe and socially just future.

Thank you for your interest and support for our work.

Varsha Vijay, Ph.D.
Technical Director
Science Based Targets Network

> ”
>
> By taking enough of the right actions, in the right places, and at the right time through science-based targets, companies can contribute towards an environmentally safe and socially just future.

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PLEASE NOTE THE FOLLOWING CONVENTIONS USED IN THIS DOCUMENT:

- Orange text signifies a link will be added in the final version
- Numbers in brackets, for example (1), indicate citations which can be retrieved in the bibliography
- Superscript numbers, for example,[1] indicate explanatory notes, which can be found as footnotes in the Method Scope and as endnotes for the rest of the Guidance.

Introduction
Step 3: Freshwater

Science-based targets (SBTs) are defined as measurable, actionable, and time-bound objectives based on the best available science that allow actors to align with Earth's limits and societal sustainability goals.

For freshwater, this refers to what the latest hydrological science says is necessary to meet local thresholds.

1.1 General approach

The approach to setting SBTs for nature is based on the underlying DPSIR (Drivers, Pressures, States, Impacts, Responses) framework (please see the Methods Scope for additional information), which can be used to understand the relationship between anthropogenic **pressures**, including those driven by company actions, and the **state of nature.**[2] For example, the pressure of freshwater pollution negatively impacts the state of nature corresponding to freshwater quality.

There is a five-step process to set SBTs for nature:

- ***Step 1: Assess***—screen and estimate impacts
- ***Step 2: Interpret & Prioritize***—set target boundary and prioritize
- ***Step 3: Measure, Set & Disclose***–set and validate targets
- (*Step 4*) *Act*–develop action strategy; and
- (*Step 5*) ***Track–Measurement, Reporting and Verification*** (MRV).[3]

This process in terms of freshwater target-setting is shown in Figure 1.

In Steps 1 and 2, companies will have screened their economic activities for materiality, completed an initial place-based assessment of pressures and states, defined the target boundary for each pressure with relevant SBTN methodology for target-setting, and prioritized locations to set SBTs for nature.

These steps are shown at the top of Figure 1. In locations where a company's **water use** and **nutrient pollution**[4] in freshwater systems indicate that they *must* set the relevant Freshwater SBTs (freshwater quantity and quality) for a given basin, companies must use the guidance within this Step 3 Freshwater method document. Data collected by companies during the Step 1b value chain assessment may facilitate the calculation of the target baseline but may only be used directly for the baseline when consistent with the guidance found in this document.

In the target-setting process, companies setting a Freshwater SBT should utilize a model to predict, for a given water system and users, the maximum allowable pressure to maintain a desired state of nature (the threshold), as shown in the bottom of Figure 1. Continuing to use pollution as an example, the target would define, for each basin, the maximum amount of pollutants that a company could discharge while maintaining acceptable freshwater quality for species or ecosystems.[5]

Companies *must* set Freshwater SBTs for their sites (direct operations) and upstream activities within their target boundary consistent with Step 2: Interpret & Prioritize (refer to the guidance in Step 1: Assess[6] and Step 2: Interpret & Prioritize[7] for more information on how to determine which sites and activities must be included). SBTN also *recommends* that companies utilize the methodology for the prioritization of target-setting found in Step 2: Interpret & Prioritize to identify top-priority basins. If companies do not apply the prioritization methodology, they will be *required* to treat all sites as top-priority basins for all basins requiring Freshwater SBTs.

Calculating science-based targets for freshwater

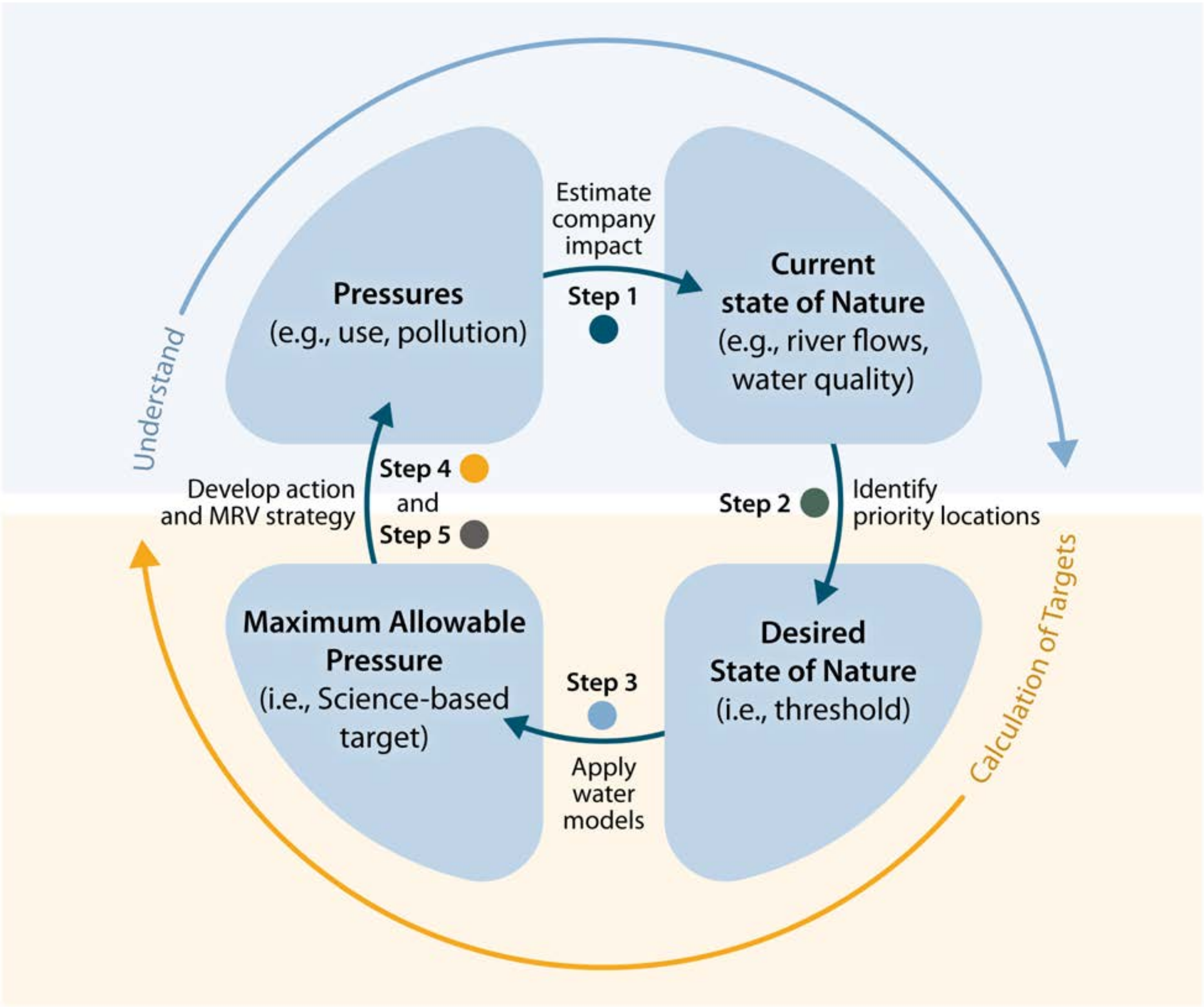


Figure 1 – High-level overview of the five steps in the target setting process as applied to freshwater. This figure shows the relationships between different pressure and state of nature variables and how companies use them in the methods.

Setting targets for freshwater requires three components:

1. **Specific indicators to represent the pressure(s) and state of nature:** Following the example above, the rate at which phosphorus (P) is loaded into a water body is an indicator of pressure, while the P concentration in the body of water would be an indicator of the state of nature.
2. **A threshold value representing the desired state of nature:** Continuing with the example, this threshold corresponds to the maximum limit on P concentration below which a healthy aquatic ecosystem can be maintained (threshold P concentration).
3. **A method to relate the desired state of nature to the level of pressure:** Completing the example, this method would consist of using a model or tool (e.g., a freshwater quality model) capable of answering the question "What is the maximum P load (pressure) that will result in staying below the threshold P concentration (state of nature)?".

The process described in this method is designed to set targets for pressures at a level necessary to protect the state of nature. These target-setting methods do not explicitly consider the risk of these pressures impacting a company's business. Companies setting SBTs for nature have the option of setting targets at a level more stringent than those required to protect nature if they find that the nature-based targets are not sufficiently stringent to protect business risk. When companies utilize this option, they *must* still submit the appropriate science-based target to SBTN but are *recommended* to provide additional detail on their reasoning for a more ambitious target value to inform further technical developments.

When setting targets for freshwater using Step 3: Measure, Set & Disclose of the five-step methodology, companies must complete four components (Figure 2). The same approach is followed for setting both Freshwater Quantity and Freshwater Quality targets.

The four phases of the freshwater target-setting process are:

1. The company *must* consult with relevant stakeholders, including national and local organizations and institutions, and the SBTN basin threshold tool (when available[8]) to determine the availability (or absence) of models specific to a given basin (i.e., developed for that basin) paired with locally based thresholds.
2. The company *must* determine the freshwater quantity and/or quality modeling approach (locally or globally developed modeling approach) and the respective threshold values representing the desired state of nature.
3. The company *must* aggregate the total pressures (i.e., water consumption and/or nutrient load) from all its activities across the given basin for the specified time period and *must* record the baseline values for these pressures.
4. The last component is target-setting, where the company sets company-specific freshwater quantity and/or quality targets for the given basin and submits them to SBTN for validation and disclosure.

The remainder of this chapter defines the specific indicators to be used, their threshold values representing the desired state of nature, and the predictive tool to be applied in calculating targets.

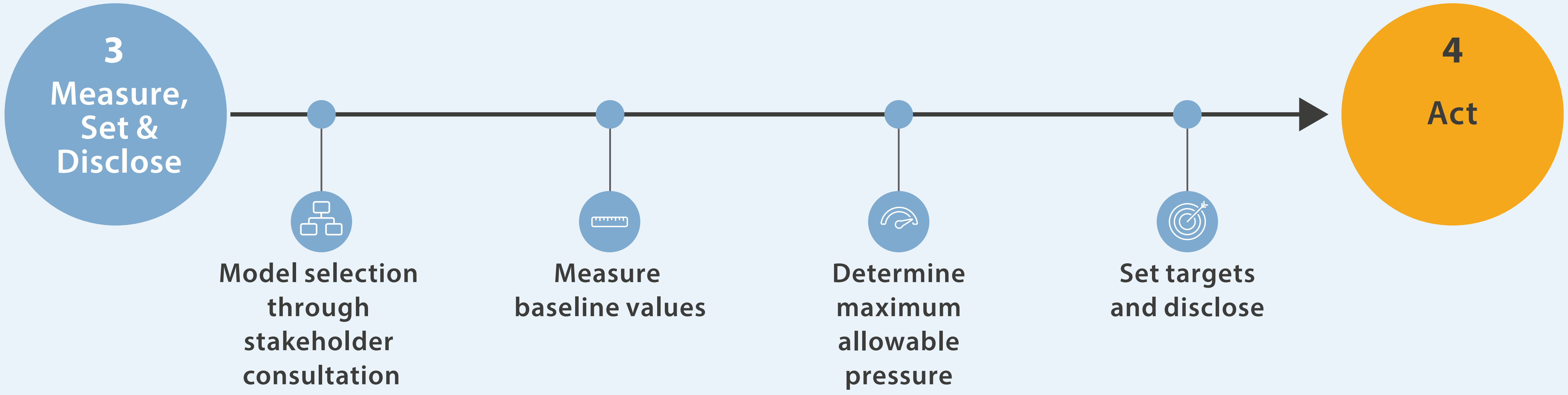


Figure 2 – Within Step 3, there are four main three substeps companies need to follow. This technical guidance describes each of these in detail.

1.2 Freshwater method scope

This document focuses on technical guidance for Step 3: Measure, Set & Disclose for companies to measure baselines for specific indicators and set Freshwater SBTs. These are the first methods released by the SBTN for Step 3 and are not expected to be usable by all companies for managing their impacts on freshwater. Table 1 summarizes what is and is not included in this version (Version 1) of the methods for setting Freshwater SBTs.

This version focuses on the following pressures on nature:

Water quantity: freshwater withdrawals from surface water bodies and groundwater, and

Freshwater quality: the total amount of nitrogen and phosphorus entering a surface water body during a given time.

These pressures are selected because (1) they are the pressures most relevant to the impacts that a large percentage of corporations pose on freshwater, and (2) methods are available to define SBTs that link these pressures to a healthy state of nature. Furthermore, this version considers only direct operations and upstream scope (not downstream scope), as methods to define quantitative target levels are currently available for these aspects of business scope.

While biodiversity does not appear explicitly as part of the Step 3 Freshwater methods, it is embedded implicitly within them. SBTN recognizes that the health of freshwater biodiversity and that of freshwater systems are interlinked and, in some contexts, may not even be distinguishable. Hence, all actions to maintain or improve the state of nature will effectively support biodiversity. In Steps 1 and 2, companies must incorporate biodiversity state of nature metrics to prioritize action on Freshwater targets in basins critical for mitigating biodiversity loss. An example of a biodiversity metric indicated in these methods that is relevant for freshwater systems includes range-size rarity for freshwater species.

In Step 3 Freshwater guidance, the sub-step by which desired environmental conditions are set considers biodiversity needs and issues. The water quantity threshold accounts for the maintenance or enhancement of the freshwater ecosystems, including the needs of specific species, through the use of environmental flow requirements. Similarly, water quality thresholds for nutrients used in this method are linked to eutrophication of freshwater ecosystems to avoid impacts on freshwater species and ecosystems. Further explanation on the inclusion of biodiversity is provided in a supplemental ***Biodiversity Report***, to be followed by a more detailed gap analysis following the release of the first release of science-based targets for nature methods.

STAKEHOLDER CONSULTATION AND STAKEHOLDER ENGAGEMENT

National-level and local-level (stakeholder) consultation in Step 3 Freshwater guidance aims to support a company in its model selection. This process is distinct but related to the broader stakeholder engagement process that a company should undertake throughout its target-setting journey. More information regarding the broader stakeholder engagement process is provided in a separate SBTN ***Stakeholder Engagement Guidance document.***

1.3 Method applicability

The Sectoral Materiality Tool applied in Step 1: Assess defines which sectors are likely to have material impacts on freshwater quantity and quality. In general, business sectors that rely on agricultural products in parts of their value chain are likely to be subject to SBTs for Freshwater Quantity and Quality. In addition, sectors where water is incorporated into a product (e.g., the food and beverage industry) and/or used for industrial processes or cooling purposes are likely to be subject to Freshwater SBTs for at least Freshwater Quantity).

These methods are best suited to companies that know or can estimate the geographical location of their operations (direct operations and upstream value chain activities), so that pressures on freshwater quantity and quality can be located in specific water basins. Future iterations of these methods will expand the set of issues and impacts that can be addressed.

Table 1—Summary of content included in this first version of methods to set SBTs for nature: Freshwater.

Content included	Content not included (i.e., to be included in subsequent versions)
Freshwater Quantity	
• Surface water flows • Groundwater levels (only basins where local model/thresholds exist)	• Groundwater levels (all basins)
Freshwater Quality	
• Nutrient pollution (nitrogen and phosphorus)	• Toxic chemicals • Other freshwater quality parameters
Scope	
• Upstream • Direct operations	• Downstream
Biodiversity and Ecosystems	
• Biodiversity is included in the Step 1 and Step 2 prioritization of basins for freshwater target-setting and in the incorporation of environmental flow requirements and nutrient concentration thresholds, which protect freshwater species and ecosystems	• Freshwater species and direct conversion of freshwater ecosystems
Future projections	
	• Consideration of forward-looking scenarios, including how future climate change will impact water availability and quality

Minimum data requirements

Setting Freshwater SBTs requires data collection and management. Please see Step 1: Assess guidance for how companies can leverage existing work, capacity, and resources when setting SBTs for nature.

Companies are required to collect data in order to define their **baseline** level of pressure for freshwater quantity and/or quality (also referred to in Step 1: Assess and Step 2: Interpret & Prioritize as freshwater use and pollution) for all basins in their direct operations and upstream scope for which targets will be set.[9] When gathering baseline data for target-setting, where possible, companies should use data from the last five full years of operation at a given site (direct operations) or purchases of a given commodity or service (upstream activity), unless this time period is not representative of their operations or typical environmental conditions.[10] The minimum data requirements for pressure baseline measurements are summarized in Table 2.

Table 2—Minimum data requirements for pressure baseline measurements.

STEP 3: MEASURE, SET & DISCLOSE

	Data Requirement	Data Sources	Unit of Measurement
FRESHWATER QUANTITY			
Direct operations	Primary/direct measurements	Water meter	Volume per month, e.g., ML/month
Upstream	Primary/direct measurements (preferred, if available)	Water meter or water diversion	Volume per month, e.g., ML/month
	Secondary	Blue-water footprint[11]	Volume per month, e.g., ML/month
FRESHWATER QUALITY			
Direct operations and Upstream	Primary/direct measurements (point sources)	Discharge flow and nutrient concentration	Volume per month, e.g., ML/month (for discharge flow) Mass of nutrient per volume, e.g., mg P/L (for nutrient concentration)
	Secondary (nonpoint sources)	Locally developed model results or Gray-water footprint	Mass of nutrient load per month (if based on locally developed model results) or Volume per year, e.g., ML/year (if based on gray-water footprint)

2.1 Freshwater quantity pressure baseline

Water quantity pressures from direct operations *must* be calculated from **primary data**, i.e., direct site-specific measurements from water meters. The required units are the average withdrawal volumes over the course of each month. Sites that have nonconsumptive water use, such as cooling water, *may* report net withdrawals (i.e., gross withdrawals minus return flow), but only in cases where the nonconsumptive flow is returned at the same time and location[12] as the withdrawal and provided that the return does not significantly impact key freshwater quality parameters.

Water quantity pressures from upstream activities can be calculated either from primary data **(direct measurement data)** or from **secondary data (modeled estimates)** using blue-water footprint(s).

The required units for primary data are average withdrawal volumes over the course of each month. The units for secondary data sources are annual average water consumption.

Use the last five full years of operation to calculate baseline freshwater quantity pressures. If data from the last five full years of operation is not available, a duration of less than five years can be used.[13] If a single facility withdraws from several rivers or groundwater sources, expand the basin size to capture all sources.

2.2 Freshwater quality pressures

The data required to determine freshwater quality pressures for direct operations and upstream activities depends on the pollutant source.

Point sources (i.e., discharges from a single identifiable conduit, such as a discharge pipe from a wastewater treatment facility) require primary data consisting of monthly average discharge flow and nutrient concentration.

Pressures for **nonpoint sources** may be estimated from secondary data, either from the results of the locally developed model (see section 3.1.1. for a description) used for target-setting or from gray-water footprint(s). The required units for primary data (locally developed model) are average nutrient load over the course of each month. The required units for secondary data (e.g., gray-water footprint(s)) are the annual average water volume required to assimilate the nutrient load.

Use the last five full years of operation to calculate baseline freshwater quality pressures. If data from the last five full years of operation is not available, a duration of less than five years is acceptable.[14]

Process for setting Freshwater SBTs

Section 3 of this document details steps on the selection of a locally developed or globally developed modeling approach (section 3.1), establishing baseline values on relevant pressures (section 3.2), and setting Freshwater Quality and Quantity targets (sections 3.3 and 3.4).

3.1 Model selection

3.1.1 OUTLINE OF LOCALLY AND GLOBALLY DEVELOPED MODELING APPROACHES

Freshwater SBTs rely on local information to indicate what a given ecosystem and its users need. The need for location-specific inputs to set Freshwater SBTs can be demonstrated through the following examples:

- The environmental flow (e-flow) requirements representing the desired state of nature in a lowland river will be different from the e-flow requirements for a headwater stream.
- The level of nutrients resulting in acceptable algal growth in a clear lake with high levels of sunlight penetration will be different from the level in a turbid stream with little sunlight penetration.
- The relationship between nutrient load and the resulting state of nature will depend on the hydraulic characteristics of the receiving water body. Much of the phosphorus (P) load delivered to a slow-moving water body may settle out of the water column prior to being carried to downstream reaches, while the P load delivered to fast-moving streams may not settle out.

For Freshwater SBTs to be effective, pressure mitigation and implementation actions must be applied in the local basin.[15] Referencing basin-specific conditions is therefore required to determine the threshold values representing the desired state of nature, to define the relationship between the pressures and the desired state of nature, and ultimately to set Freshwater SBTs.[16]

The level of resources (i.e., data, time, and effort) required to accurately define Freshwater SBTs can be substantial, depending on the science and data availability.[17]

Because models and thresholds for freshwater quantity and quality that have been locally endorsed and validated are not yet available in many parts of the world, SBTN accepts the use of two different modeling approaches. The selection of the modeling approach must correspond to local data availability.

These approaches can be summarized as follows:

- **Locally developed modeling approach:** Targets are based on hydrological and/or freshwater quality models specific to a given basin (i.e., developed for that basin), paired with locally based thresholds, emphasizing those which are recognized by the local basin management authority or water resources management agency. Stakeholder engagement is a critical part of ensuring that the model and threshold chosen are appropriate and compatible with corporate data.
- **Globally developed modeling approach:** Targets are based on global hydrological and/or freshwater quality models and paired with thresholds that are either globally defined (i.e., freshwater quality thresholds) or based on the results of global models (i.e., freshwater quantity thresholds). Local stakeholder engagement is used to ensure alignment on the application of a global model in a given basin. In cases where a local model and threshold are not available, global models represent the best available science to inform science-based targets.

Identifying and consulting with relevant stakeholders, including national and local organizations and institutions, is critical to the selection of the modeling approach. Section 3.1.2 provides more information on the model selection.

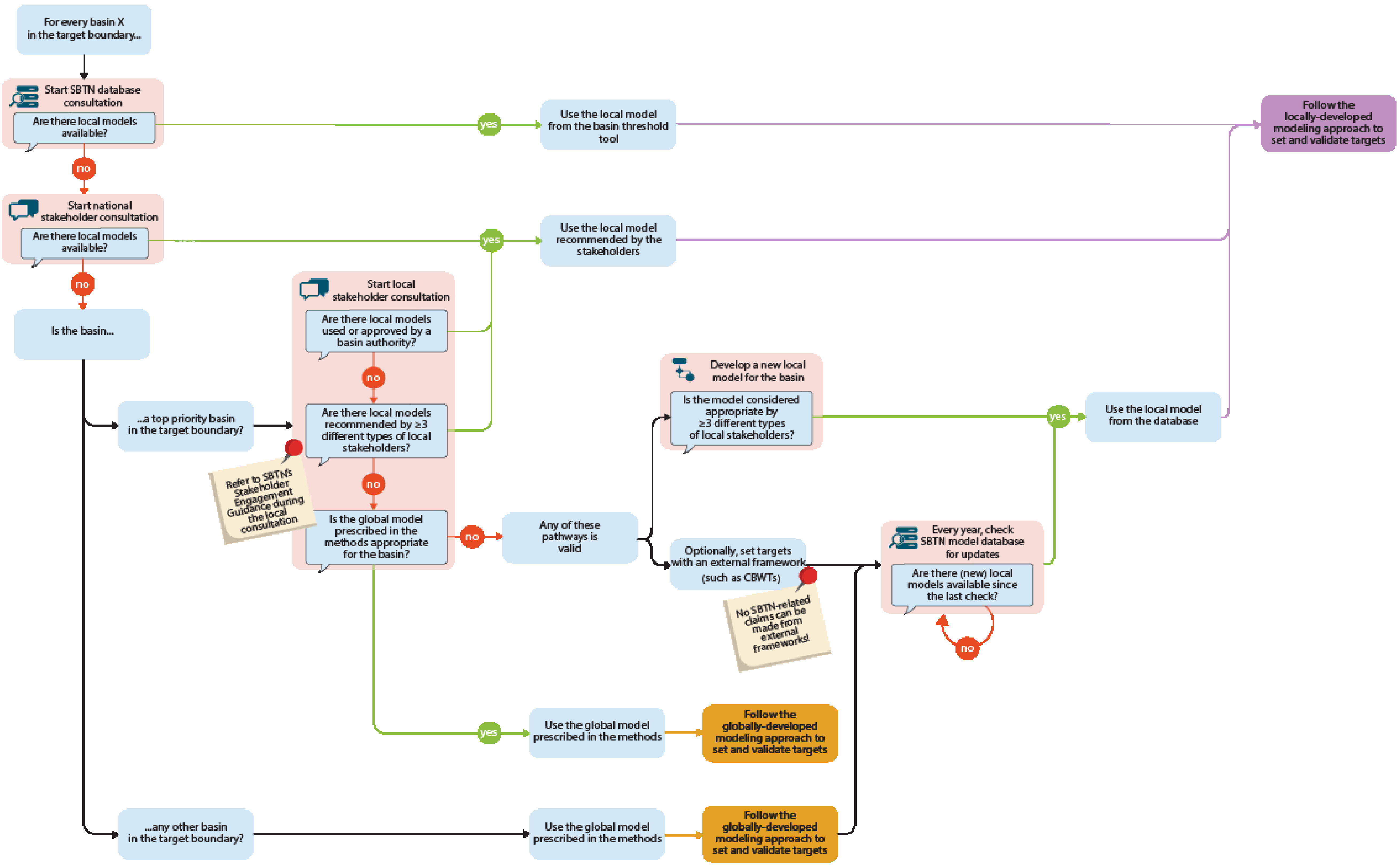


Figure 3: – This decision-tree illustrates the process to select a modeling approach (either globally-determined or locally-determined) through a series of database and stakeholder consultations.

3.1.2 MODEL SELECTION DECISION-TREE

Figure 3 shows a decision-tree that companies can use to guide their selection of a locally or globally developed modeling approach. Companies are *required* to follow this decision-tree to determine which approach is to be applied for each basin in which priority sites have been identified under Step 2: Interpret & Prioritize.

The selection process has been designed to balance the need for scientific rigor and practicality. It prioritizes the use of local models in top-priority basins and aims to minimize the consultation burden for companies and all other stakeholders. Once the modeling approach has been selected, companies will be able to define the spatial scale for target-setting (section 3.2.1) and record their baselines (sections 3.2.2 and 3.2.3). Even though the model selection process includes iterations on the model selection (e.g., if a better model is found during the initial validity period of the targets), the original baseline—and any progress made on it—will be recognized when companies recalculate their targets.

> *Note that the national-level and local-level consultation in this section aims to support a company in its model selection. This guidance is distinct but related to the broader stakeholder engagement process that a company should undertake throughout its SBT-setting journey (Steps 1-5). More information regarding the broader SBTN stakeholder engagement process is provided in a separate Stakeholder Engagement Guidance document.*

The first stage of the consultation process consists of checking the SBTN basin threshold tool (which is under development) for available **local models**. This tool will contain local models and thresholds that have either been used by other companies that have set and have had externally validated SBTs in the basin or have been identified and approved through research efforts by the SBTN Freshwater Hub. SBTN will populate this tool as companies set and validate targets using local models, so that coverage will increase as time goes on. While the tool is in development, companies can skip this first node in the decision-tree and proceed to the national-level consultation.

The second stage of the consultation process involves **national-level stakeholders.** Companies are *required* to consult either of the following on the existence of any appropriate local model for the basin of interest:

i. National water authorities or ministries involved in water resource allocation; or

ii. Country offices of SBTN Freshwater Hub partner organizations (WWF, The Nature Conservancy, Pacific Institute, and World Resources Institute).

Companies should identify all basins that fall within the same national jurisdiction to expedite this process.

An **appropriate local model** is one that, in the opinion of the consulted stakeholders, meets most of these criteria:

- Safeguards aquatic ecosystems and their ecological services by including environmental flows and natural flow regime alterations.
- Accounts for major anthropogenic disturbances to surface flows, for example from dams or canals (cross-basin transfers).
- Accounts for (allocated) water resource use rights and for acceptable water access for the population.
- Accounts for major anthropogenic fluctuations in groundwater levels (for water quantity only).
- Accounts for national or international water quality standards for nutrient pollutants (for water quality only).
- Accounts for major anthropogenic sources of nutrient pollutants in the basin (for water quality only).
- Has been ground-tested in the basin or its predictions have been corroborated by observed data.

In addition, either the local model must allow for the calculation of thresholds for the basin or a locally based threshold for the basin must be already known and in use by local stakeholders.

Companies may include additional criteria for stakeholders to use when assessing the appropriateness of a local model. Companies must record the assessments of stakeholders on these criteria and be ready to submit these records as part of the documentation for the validation process. Stakeholders must give their consent to be quoted; otherwise, companies must anonymize their comments and report which type of stakeholder provided which comments.

If the national-level consultation leads to an appropriate local model, the company must use it for target-setting. In cases where multiple local models are found, companies should follow the recommendation from the stakeholders regarding which one is preferred. As part of the validation process, companies must submit a brief assessment of the local model's appropriateness by national stakeholders (based on the above criteria and/or others deemed relevant by the consulted stakeholders).

If the national-level consultation fails to deliver any appropriate local models, companies must refer to the results of Step 2: Interpret & Prioritize process, where the basins have been ranked according to the company's pressures and state of nature (including biodiversity), to understand how to proceed with each basin. Top-priority basins will require companies to invest more effort in finding local models, while other basins in the target boundary will allow companies to directly use global models.

From the ranking of sites completed in Step 2, companies must consider the following categories:

- **Top-priority basins:** Based on the Step 2 prioritization exercise, companies should consider the highest 10% of basins, or 10 basins if there are more than 100 basins in the target boundary, as top-priority basins.
- **Other basins in the target boundary:** All other basins in the target boundary are considered part of this category.

Companies should be aware that the ranking of basins, determined by Step 2: Interpret & Prioritize, may be different for water quantity than for water quality, depending on the company's pressures and the state of nature at each site. In other words, the same basin might be considered a top priority basin for water quality but not for quantity. Companies are required to keep these lists and rankings separate for validation, but are recommended to proceed with the consultation process simultaneously to expedite it and reduce stakeholder burden. As part of the prioritization approach, companies may choose to develop targets in basins that are considered top priority for both freshwater quantity and quality or also priorities for Land SBTs.

For all basins considered top-priority basins, companies must identify **relevant local-level stakeholders** and approach them to consult on the existence of appropriate local models. Refer to section 3.1.3 for further guidance on the stakeholder identification process.

The consultation with local-level stakeholders consists of the following three questions:

1. ***Are there local models used by the local water authority(-ies) to manage water quantity or water quality in the basin?***

   If there are, the company is required to use the same models for its target-setting and can end the local-level consultation. Otherwise, the company proceeds to the second question.

2. ***Are there appropriate local water models supported by at least three different types of stakeholders?*** (Refer to the description above to understand the criteria to consider a local water model appropriate for target-setting, and to the stakeholder identification in section 3.1.3) for the list of stakeholder types that can be consulted.)

   If there are, the company is *required* to use those models for its target-setting and can end the local-level consultation. If multiple local models are supported, the company should use the model with the most stakeholder support. If none of the models is supported by at least three types of stakeholders, the company proceeds to the third question.

3. ***Are the global water models—those provided by SBTN in sections 3.3.1 (water quantity) and 3.4.1 (water quality)—appropriate to use in this particular basin?***

   If the global models are appropriate for the basin, the company is required to use those models to set its target. Otherwise, the company can conclude that no appropriate model, neither local nor global, is available for the basin. Further guidance is included below on how to proceed.

Global models are considered appropriate to be used in a given basin if, in the opinion of local stakeholders:

- The basin does not have major interbasin water transfers, dams, or other diversions that are not accounted for by the model.
- The basin does not have major disputes as to water rights or water access that are not accounted for by the model.
- The basin does not have major anthropogenic disturbances to nutrient flows that are not accounted for by the model.
- The basin does not have threatened (terrestrial or freshwater) species or ecosystems that are highly dependent on water flows beyond the global model's considerations for e-flows.
- The basin does not have threatened (terrestrial or freshwater) species or ecosystems that are highly sensitive to freshwater nutrient concentrations or dissolved oxygen (DO_2) concentrations.
- The global model has not been challenged by local stakeholders in the past for being inaccurate to the water regime in the basin.

Companies may include additional criteria for stakeholders to assess the appropriateness of global models to local basin conditions. Companies must record the assessment of stakeholders on these criteria and be ready to submit these records as part of the documentation for the validation process. Stakeholders must give their consent to be quoted, otherwise, companies must anonymize their comments and report which type of stakeholder provided which comments.

For top-priority basins, where no appropriate local or global model is available, companies *can* proceed with either of the following two options: both options are equally valid for target-setting, and the company can choose its preference depending on the resource availability and interest in the basin.

1. Companies *may* fund the development of local models for the basin. Due to noted risks associated with company-funded research,[18] companies engaging in this option will be required to establish an independent advisory body (composed of at least five independent stakeholders with no financial or other relationship to the company) to verify that the local model and threshold are appropriate and open access, and that the science underlying the model is being used without regard for financial implications for the company and in best service of the science underlying the SBTs.

   For use in the SBTN methods, companies must ensure that a majority (at least three of the five stakeholders) agree that the model and threshold are appropriate to use and the research has been conducted with the aim of representing the best available science. Companies may then use the model to set SBTs once the safeguards are met. As part of the validation process for these targets, companies will submit the model (including verification of open access), supporting methodological documentation, and stakeholder evaluation.

2. Companies *may* wait until a local model is developed and, in the meantime, pursue target-setting using external frameworks or standards, such as contextual water targets or the Alliance for Water Stewardship (AWS). However, companies *will not* be able to make any claims with SBTN about having SBTs for these basins. When presenting information related to their target coverage, companies will indicate that this basin does not have SBTs due to the lack of adequate models.

   - Once the SBTN basin threshold tool is published, the company will consult the tool annually to see if a local water model has been included. If a new model and threshold are found, the company will be required to use it to set targets and will be able to submit them for validation. Once these targets are validated, the company will be able to make standard claims associated with setting SBTs.

For "all other basins in the target boundary," companies *may* use global models to set and have validated targets. Companies *may*, optionally, search for appropriate local water models, but this is not required. SBTN encourages companies to prioritize action through target-setting, and subsequent actions to achieve these targets, by setting and having validated targets with the global model, since it represents the current best available science. For this reason, companies are encouraged to use global models and thresholds to set **directionally correct targets**[19] where no other options are readily available, noting that in these cases (where the global model is used) the target value will be subject to revision on an annual basis as coverage in the SBTN basin threshold tool expands.

> The model selection process has been designed to balance the need for scientific rigor and practicality.

3.1.3 RELEVANT LOCAL-LEVEL STAKEHOLDERS

Relevant local-level stakeholders are those with specialized knowledge and insights relevant to the basin or hydrological science. Companies *should* start with an internal consultation within their company and/or supply chain to identify the stakeholders that may have relevant information to inform the modeling approach selection (refer to section 3.1.1).[20]

Based on the Organisation for Economic Co-operation and Development (OECD) and AWS guidance on stakeholders in the water sector,[21] SBTN derived a list of five key basin stakeholder groups that are likely to have relevant information to inform the modeling approach selection. For the local-level stakeholder consultation, companies *may* consult any combination of the following:

- Water management agencies/basin authorities. Authorized basin agencies are governmental agencies that have the authority to make decisions on the allocation of water resources. Examples include basin management authorities, water resource management agencies, and catchment councils.
- Governmental regulators (water quantity/quality).
- Scientists and academics involved in the basin.
- Local water-related NGOs or local chapters of international NGOs (WWF, TNC, etc.).
- Local communities and/or indigenous groups or their representatives.
- Relevant local departments involved in water supply to the facility.

Through this consultation, companies are *required* to document whether stakeholders were able to do the following:

- Identify existing local thresholds or targets (at the outset of the process).
- Identify the scientific model/approach (locally developed modeling approach).
- Provide/share local models, thresholds, and/or data (locally developed modeling approach).

> *Note: If a company is planning to set a Landscape Engagement target following the Step 3 Land methods in the same basin as a Freshwater quantity/quality target using a local model, it should follow the above steps for setting a Freshwater target first before setting a Landscape Engagement target.*

Companies will be required to provide this documentation as part of their validation submission (see section 3.1.4 for more information).

3.1.4 VALIDATION CRITERIA FOR CONSULTATION[22]

Companies *must* document the following:

A. A stakeholder mapping exercise within the basin of interest (refer to section 3.1.3 for identifying relevant local stakeholders), prioritizing stakeholders who are knowledgeable about existing models and thresholds in the given basin.

B. (If relevant local stakeholders are identified) Documentation summarizing whether relevant local stakeholders are able to support: (i) the identification of any existing local thresholds/targets, (ii) the identification of a scientific model/approach, and (iii) the provision/sharing of local models, thresholds, and/or data (see section 3.1.3).

C. A record of the person(s) contacted at the basin management authority (or water resources agency) for the given basin, and their response, regarding the existence of local models/thresholds for freshwater quantity and/or quality. This information is required for the justification of the modeling approach selection.

3.1.5 HYPOTHETICAL EXAMPLES OF CONSULTATION

This section provides hypothetical examples of how Ursus Nourishment—a fictional food and beverage producer—would consult stakeholders to determine which model to use for target-setting.

Ursus Nourishment specializes in plant-based drinks and food. The hypothetical data used comes from the SBTN case study in Step 1: Assess and Step 2: Interpret & Prioritize. Based on Steps 1 and 2, Ursus analyzed materiality, value chain pressures, and state of nature. Commodity target boundaries were determined for climate change, land use, land-use change, water use, soil pollution, and water pollution. The following hypothetical examples will focus on consultation for water use and water pollution for the top three priority basins within the direct operations target boundary (in France and Spain) identified at the end of Step 2. Please consult the standalone case study document for more information.

The Ursus team begins by checking the SBTN basin threshold tool (when available[23]) for the one basin in Spain and two basins in France where its priority activities are located. The team then identifies that the basin in Spain has a local model available, but the ones in France do not.

The team then moves on to national-level consultation. For Spain, since Ursus has an existing contact at the Spanish government's Ministry for the Ecological Transition and the Demographic Challenge, which oversees water management in the country, the team shares its plans to use the model identified in the SBTN hydrological model database with this contact. This representative of the ministry confirms that this model exists and is appropriate to use for Ursus' target-setting process.

For France, the team begins with a stakeholder mapping exercise that lists the stakeholders it is in contact with across the national and local categories of stakeholders identified in the SBTN guidance (see sections 3.1.2 and 3.1.3). After this list is created, the Ursus team reaches out to the stakeholders it has identified. Ursus approaches the country office of WWF (an SBTN partner organization with whom Ursus has previously partnered) to consult them on the existence of any appropriate local model for their two basins of interest. WWF reaches out to a contact they have at the National Research Institute for Agriculture, Food and the Environment in France (the INRAE) and the various WWF staff who have worked on water issues across the country. The WWF's contact shares that they have been informed of a freshwater quality model and local nutrient concentration thresholds that have been developed for the basin where Ursus' manufacturing and packaging facilities are located (*Bassin Un*). However, the WWF's contact does not believe that a local hydrologic model with e-flow requirements exists for that basin or that any models (for water quality or quantity) exist in the second basin in western France where Ursus grows crops (*Bassin Deux*). The WWF's contact provides the contact information of the university that developed the model for the *Bassin Un* and the *Comité de Bassin* (river basin committee) as well as contact information for a few stakeholders in the *Bassin Deux.*

Ursus then moves to local-level consultation in France. For the *Bassin Un*, Ursus speaks with the university and the river basin committee provided by WWF and receives the model information from the university by email. Ursus also talks to its local facility managers, who speak to their water provider and a local NGO in the community, both of which confirm that the model provided by the university is the preferred data source on freshwater quality and local nutrient concentration thresholds. For the *Bassin Deux*, Ursus talks to its local farm managers, who speak with their water provider and the local community, neither of which is aware of any local models for water quantity or quality. Ursus then reaches out to the contacts provided by WWF at the river basin committee, regulator, and university: none of these stakeholders is aware of any local models for water quality or quantity either.

Ursus completes the process by documenting its stakeholder mapping (list of all stakeholders), all the email exchanges with identified national- and local-level stakeholders in France and Spain, minutes and attendance of stakeholder meetings, and the data provided for the Un basin. Ursus decides to use the locally developed modeling approach for water use in Spain and for water pollution in the *Bassin Un* in France, and the globally developed modeling approach for water use and water pollution in the *Bassin Deux* in France. See sections 3.3.6 and 3.4.6 for the continuation of these hypothetical examples.

3.2 Baseline values on relevant pressures

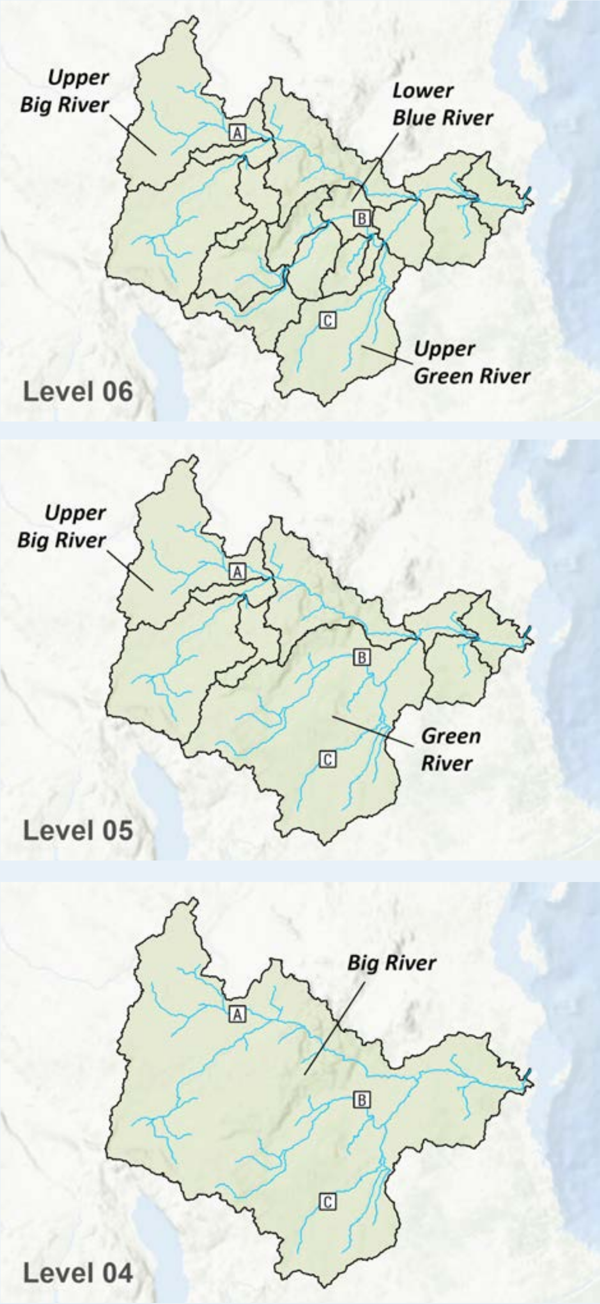
3.2.1 SPATIAL SCALE

Freshwater SBTs are to be set for priority sites at the basin level. Basins are defined at different degrees of spatial aggregation depending on the number of tributaries feeding into the downstream water body (e.g., by using the Pfafstetter Coding System, a hierarchical method of coding river basins—see Glossary for further definition). Before taking baseline measurements, companies must define the spatial scale (i.e., basin and level of aggregation) for which targets will be set.

The basin level used by companies will be determined by the modeling approach they select (see section 3.1) and the pressure targeted (i.e., withdrawals and/or pollution) and may be a finer scale than used for the Step 1 and 2 methods. For example, in the globally developed approach for freshwater quantity that applies *Hogeboom's water quantity global model*[28], Pfafstetter Level 5 basins would be used; whereas in the globally developed approach for freshwater quality that applies McDowell et al. (2020),[24] Pfafstetter Level 4 basins would be selected. The basin level for the locally developed approaches will depend upon the specific local model.

Companies will need to compile their sites by the basin level used in the model to ensure that targets consider all sites at the selected spatial scale. The concept of compiling sites by basin level is illustrated in Figure 4 for a company with three priority sites (sites are shown as lettered squares in Figure 4). At Level 6, each of these sites is located in a different basin. At Level 5, sites B and C are located in the same basin, while site A is located in a separate basin. At Level 4, all three sites are located in the same basin.

The table in Figure 4 shows the compilation of sites and the basins they reside in at the different Pfafstetter levels. Once the appropriate basin level is determined, this compilation can be used to identify the specific basins within which to set targets. For example, the globally developed modeling approach to freshwater quantity using *Hogeboom's water quantity global model*[28] requires the use of Pfafstetter Level 5, dictating that targets will be set specifically for the Upper Big and Green River basins. The globally developed modeling approach to freshwater quality requires the use of Pfafstetter Level 4, dictating that targets for all three priority sites will be set as part of a single basin.[25]



	Basin by Pfafstetter Level		
Operation	6	5	4
Site A	Upper Big River	Upper Big River	Big River
Site B	Lower Blue River	Green River	Big River
Site C	Upper Green River	Green River	Big River

Figure 4—Compiling priority sites by basins at different Pfafstetter levels. Hydrological basins should be aggregated to the correct level, depending on the target-setting process described in this guidance document. The figure shows the relationship between different levels, where the larger basins (e.g., level 4) contain the smaller basins (e.g., level 5 or 6).

Locally developed modeling approach
There is no fixed requirement regarding the basin level for setting Freshwater SBTs using the locally developed modeling approach because the spatial domain for this approach will typically be dictated by the available model(s). The AWS Standard[26] recommends that the scope of the analysis be large enough to do all of the following:

- Contain the upstream land area or aquifer contributing to your sites' water source(s).
- Contain the downstream areas affected by your sites' nutrient loads.
- Contain the upstream and downstream areas of impacts for other actors that are contributing to the water challenge.

When determining the scope of analysis, the maximum allowable distance from a pressure in the basin of interest can be defined as the distance at which a site's actions can still be distinguished from background conditions, in terms of either freshwater quantity or freshwater quality. As noted in "*Setting Site Water Targets Informed By Catchment Context: A Guide For Companies*,"[27] consideration *may* also be given to (1) using the same catchment boundaries as the appropriate water governing body, and (2) soliciting stakeholders' input on an appropriate spatial scope. If a large basin (i.e., Pfafstetter Level 4) is selected, companies must demonstrate that targets protect thresholds at each of the Pfafstetter Level 5 sub-basins.

Globally developed modeling approach
The basin levels for setting Freshwater SBTs using a globally developed modeling approach are directly specified and vary depending on the pressure targeted and chosen model. For Freshwater Quantity targets, companies *must* use Level 5 basins for setting targets, consistent with the scale of data provided by *Hogeboom's water quantity global model*.[28]

- Companies *must* use Level 4 basins for setting Freshwater Quality targets, consistent with the scale of data provided by the global nutrient modeling of McDowell et al. (2020).

3.2.2 FRESHWATER QUANTITY BASELINE VALUE

Once the spatial scale for each baseline is selected, the company can calculate its baseline value. The aggregation of total water withdrawals from all the company's activities within a specified basin level and time period is recorded as its "water quantity baseline value" in this basin. The company *must* define its freshwater quantity baseline value for each of the basins within the target boundary (as defined in Step 2: Interpret & Prioritize).[29] The company can also leverage data and information collected in the value chain assessment in Step 1: Assess to calculate its Step 3 baseline.

The output of this step in the target-setting process is a measurement of a company's baseline withdrawals as an indication of its overall water use, for each basin. Future withdrawals will be compared with the calculated freshwater quantity baseline value to assess progress on the company's Freshwater Quantity targets.

Data disaggregation requirements
Primary (direct measurement) and secondary (modeled estimates) data *must* be separated for baselining and target-setting. Direct operations and upstream data *must* also be disaggregated by primary or secondary data for target-setting in a given basin. Note that upstream sites will often be more reliant on secondary data. Primary and secondary data *may* be combined only for high-level communication purposes.

Direct operations
For a company's direct operations, the freshwater quantity baseline value *must* be defined based on primary data (i.e., metering of water use) for all priority sites (refer to Table 2 in section 2).

Upstream
For a company's upstream value chain, the baseline value *may* be calculated using either primary or secondary data sources. For companies using secondary data sources (particularly the case for companies sourcing from agricultural suppliers), companies can use the information they collected in Step 1: Assess and Step 2: Interpret & Prioritize, such as the number of products/commodities produced, to estimate water consumption using tools such as blue-water footprint(s) to convert product/commodity production into units of volume of blue water used per time (see Table 2 in section 2).[30] This data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.[31] As in Step 1: Assess, upstream baseline estimates should use location data for commodities that is spatially resolved to at least the country level.

Companies *must* use the average aggregate withdrawals[32] over the last five full years of operation to represent the baseline, unless this time period is not representative of their operations or typical environmental conditions. Operations that have been in existence for less than five years (or have collected data for less than five years) *should* use the average aggregate withdrawals over the length of their existence (or period of data collection). This period accounts for both interannual variations and ongoing investment in water reductions that companies have achieved prior to setting SBTs.

3.2.3 FRESHWATER QUALITY BASELINE VALUE

Following the process for calculating the freshwater quantity baseline value (see section 3.2.2), once the spatial scale is selected, companies can calculate the freshwater quality baseline value. The aggregation of the total present-day load of nutrients from all the company's facilities (direct operations) and/or sourcing (upstream activities) locations within a specified basin and time period is recorded as its "freshwater quality baseline value." As with the freshwater quantity baseline, companies can leverage data and information from their Step 1 value chain assessment in completing the baselining requirements.

The output of this section is a measurement of a company's baseline nutrient loads or gray-water footprint as an indication of its overall freshwater pollution (for nitrogen (N) and phosphorus (P)). Future nutrient loads or gray-water footprint will be compared with the calculated freshwater quality baseline value to assess progress toward the company's Freshwater Quality targets.

The company *must* define its freshwater quality baseline value for each of the basins within the target boundary (as defined in Step 2).

Data disaggregation requirements

Primary (direct measurement) and secondary (modeled estimates) data *must* be separated for baselining and target-setting. Direct operations and upstream data *must* also be disaggregated by primary or secondary data for target-setting in a given basin. Pressures quantified as nutrient loading and pressures defined as gray-water footprint *must* be separated for baselining and target-setting. Note that upstream sites will often be more reliant on secondary data. Primary and secondary data may be combined only for high-level communication purposes.

Point sources

The data requirements for defining freshwater quality baseline values depend on how pollutants are delivered to the water body. Pollutants discharged from a facility via a confined discharge pipe (i.e., a point source) *must* be calculated from primary data. In such a case, loads are calculated by multiplying primary data on discharge flow (i.e., volume per time at the point source) by primary data on discharge concentration (mass per volume), resulting in units of mass per time (e.g., kg P/month).

For direct operations or upstream, the freshwater quality baseline value *must* be based on primary data for all point source discharges (see Table 2 in section 2) and calculated separately for both N and P. In particular, a company *must* aggregate the nutrient loads, mass of N, or mass of P[33] per time unit (such as kg P/month) from all its facilities/sourcing locations within a specified basin level and time period. For example, a company with three facilities/sourcing locations in a given basin will be *required* to sum the P loads across these three facilities/sourcing locations and report the cumulative P load in units of mass of nutrient per time (e.g., kg P/month). The same procedure is to be repeated for the N loads across these three facilities/sourcing locations to calculate the cumulative N load (in kg N/month).[34]

Nonpoint sources

It may be difficult to obtain primary data on nutrient loads from nonpoint sources,[35] so secondary data sources *may* be used to calculate baseline freshwater quality values for nonpoint sources (refer to Table 2 in section 2). Locally developed modeling approaches serve as one potential secondary data source for calculating baseline freshwater quality values, as they might consider all nutrient loads to the water body (including nutrient loads from different companies in this basin). These locally developed modeling approaches *may* be used for priority sites within a company's direct operations or upstream activities (i.e., upstream agricultural suppliers) when the company cannot otherwise get primary data.

Companies may also use the secondary data sources used in Step 1: Assess and Step 2: Interpret & Prioritize, where information on the number of commodities purchased from suppliers and produced at different sites in a company's upstream value chain is used to estimate pressures on water quality. If companies measure pressure as nutrient loading concentration (via direct measurements or modeled estimates), the pressures will be in loads of N or P (mass N/volume) into the water bodies. If companies measure pressures as gray-water footprint, these will be tracked in terms of water volume/time required to assimilate the nutrient loads. This data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.[36]

Whether companies use the average aggregate nutrient load (N and P) or the average gray-water footprint, companies must in both cases cover the last five full years of operation to represent the baseline unless operations have been in existence for less than five years or the period is not representative of typical operations or environmental conditions. Operations that have been in existence for less than five years (or have collected data for less than five years) should use the average aggregate nutrient loads over the length of their existence (or period of data collection). This period accounts for both interannual variations and ongoing investment in nutrient loads that companies have achieved prior to setting SBTs.

Indirect point sources

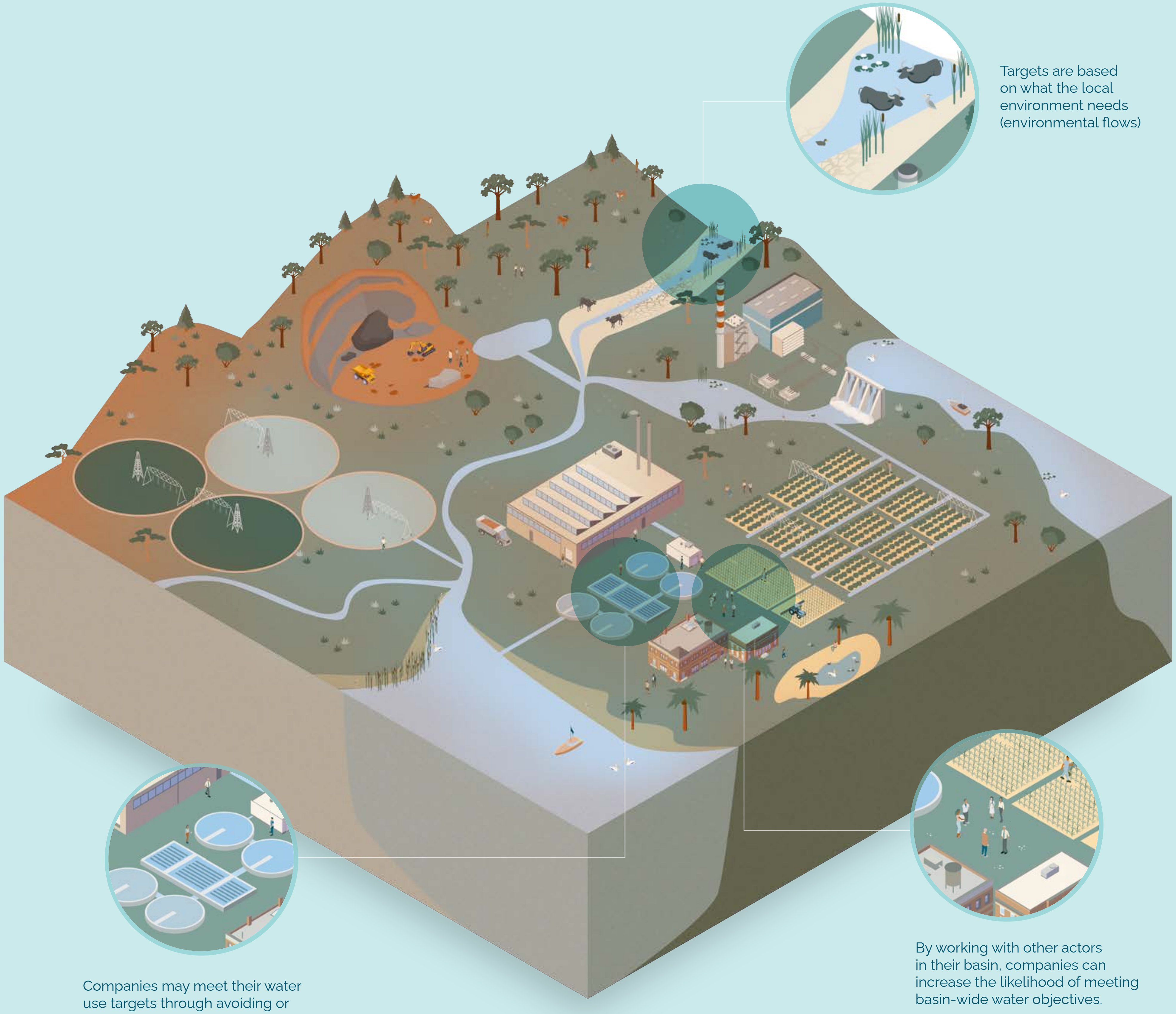
Indirect point source nutrient loads (i.e., situations in which a company's nutrient load is routed to a non-company wastewater treatment plant prior to discharge to the water body) are out of scope for this version of SBTN's Freshwater methods.

Figure 5 – Freshwater quantity targets

COMPANIES FROM ALL SECTORS CAN SET A FRESHWATER QUANTITY SBT

These targets address corporate pressures on nature through freshwater withdrawals from surface water bodies and groundwater.*

When calculating freshwater quantity SBTs, information needed includes both direct operations water use and upstream activities water use.



Targets are based on what the local environment needs (environmental flows)

Companies may meet their water use targets through avoiding or reducing water withdrawals, or by restoring flows.

By working with other actors in their basin, companies can increase the likelihood of meeting basin-wide water objectives.

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* Groundwater is only in basins where local model/thresholds exist

3.3 Setting Freshwater Quantity targets

After companies have calculated freshwater quantity baseline values for all priority sites in a given basin, they can begin to define targets for freshwater quantity for direct operations and upstream activities (the freshwater quantity targets are shown as a conceptual diagram in Figure 5). To set targets, they must next calculate the maximum allowable level of basin-wide withdrawals (water withdrawals corresponding to all water users in a given basin), specified in terms of the required percentage reduction in the present-day rate of withdrawal. Target-setting concludes by allocating a portion of this amount to the company's operations and suppliers. Targets are to be set for each basin in which priority sites have been identified in Step 2.

Note that this section is designed to produce results that are at the upper limit of what would be acceptable, such that there is no buffer built in as a margin of error. Ideally, a company would be more ambitious than these targets (i.e., set a Freshwater Quantity target that aims at reducing freshwater withdrawals more drastically than what is to be required through the targets). In that case, companies *must* submit the target value as determined using the SBTN methods but are *recommended* to also provide information on their more ambitious target value and its rationale.

3.3.1 MAXIMUM ALLOWABLE LEVEL OF BASIN-WIDE WITHDRAWALS

The process for calculating the maximum allowable level of basin-wide withdrawals depends on the modeling approach selected.

Locally developed modeling approach

If a locally developed model and locally based threshold values exist, they *must* be applied to determine the required percentage reduction in basin-wide rate of withdrawal that is in compliance with the **threshold**[37] stream flow (or groundwater recharge) regime.

The threshold values used for this approach must be endorsed by the authorized basin agency (see sections 3.1 and 3.1.3) and not independently determined by the company. If there are no threshold values that are endorsed by the authorized basin agency, then a company can use values that are supported by at least three different types of stakeholders (see sections 3.1.1 and 3.1.3). Two options exist for determining the maximum allowable level of basin-wide withdrawals for a locally developed modeling approach:

- *Direct application of model:* This option provides more flexibility in terms of consideration of groundwater and dam operations. However, it requires that a company be able to apply the locally developed model to explicitly demonstrate that the proposed target will result in the attainment of environmental flow (e-flow) requirements. This approach will require a company to gain access to the locally developed model and have the in-house technical expertise to independently conduct model simulations.

  It is most suited for situations where it is possible and feasible to apply the locally developed model and where factors such as groundwater depletion or dam operations are relevant.
- *Back-calculation from existing results:* This option uses specific equations for calculating the required percentage reduction in the level of basin-wide withdrawals, using information on e-flow requirements and modeled (or historically observed) stream flow regimes.

  It allows Freshwater Quantity targets to be set without rerunning the locally developed model. However, it assumes that freshwater withdrawals are the dominant cause of non-attainment of desired flow conditions and lacks flexibility for considering factors such as groundwater depletion or dam operations.

  It is most suited for situations where it is not possible and/or feasible to apply the locally developed model and/or where factors such as groundwater depletion or dam operations are not relevant.

Direct application of model

The first option for determining the maximum allowable level of basin-wide withdrawals within the locally developed modeling approach can be used in cases where the local model is available for purposes of evaluating specific basin-wide withdrawal reduction scenarios. For this option, the company defines the maximum allowable level of withdrawal by demonstrating that the desired stream flows (and/or aquifer level, if targets are being set for the protection of groundwater) will be attained for the targeted level of basinwide withdrawal over the entire period of simulation. Similar to the back-calculation from existing results option, allowable withdrawals should be set at a level where e-flow requirements are attained for at least 75% of each of the months over the simulation period.

In contrast with the back-calculation from existing results option, the *Direct application* of model option does not require the assumption that the rate of withdrawal at any given time is directly reflected as a reduction in stream flow. This makes the *Direct application of model* option suitable for situations where the protection of groundwater levels is an important consideration. Furthermore, this option is better suited for situations where pressures other than withdrawals (e.g., dams) are responsible for the non-attainment of e-flow requirements, as it allows the effect of alternative dam operations to be considered.

Back-calculation from existing results

This option provides a specific equation for calculating the maximum allowable level of basin-wide rate of withdrawals (volume per time, e.g., ML/month) that will attain the desired e-flow conditions (refer to Equation 1 below). This option is reliant on e-flow information and is based on the assumption[38] that the rate of withdrawal at any given time is directly reflected as a reduction in stream flow (or e-flow gap); therefore, the necessary reduction in withdrawals is the same percentage as the desired increase in stream flow (to meet the e-flow gap).

This assumption allows the present required basin-wide withdrawal reduction to be directly calculated from:

- Present-day stream flows (representing current withdrawals)
- Natural stream flows (representing the absence of withdrawals)
- Locally derived e-flow requirements.

The specification of the required basin-wide withdrawal reduction is based on the concept of "excess withdrawals," i.e., the amount by which present-day withdrawals exceed the level necessary to attain e-flow requirements. The percentage reduction required to attain e-flow requirements is calculated as *the ratio of excess withdrawal (environmental flow requirement minus present day stream flow) to present-day withdrawal (natural flow minus present day stream flow)*, see the following equation:

$$\text{\% Reduction in basin-wide withdrawal required} = \frac{\text{Excess withdrawal}}{\text{Present-day withdrawal}} \times 100$$

Equation 1

This concept is illustrated in Figure 6 using hypothetical hydrographs. The upper line in Figure 6 (natural flow) represents the natural stream flow regime, the middle dashed line (environmental flow requirement) represents the e-flow requirements, and the lower line (present-day flow) represents present-day stream flows.

For this example, present-day stream flows are consistently less than the respective e-flow requirements, indicating that the present level of withdrawal exceeds what is desired. The excess withdrawal for any given month is defined as the difference between the e-flow requirement and the present-day flow (for this example, $30x10^6$ ML/month). The present-day withdrawal for any given month is defined as the difference between the natural stream flow and the present-day stream flow (for this example, $50x10^6$ ML/month). The application of Equation 1 to this example shows that the "ratio of excess withdrawal to present-day withdrawals" is 0.6 (i.e., $30x10^6 \div 50x10^6$), which means that the basin-wide withdrawals need to be reduced by 60% to attain e-flow requirements.

Equation 1 *must* be applied for each basin within the target boundary, over the entire period for which flows are available,[39] with results tracked for each month of each year. This will generate a matrix of required reduction percentages for each month and year. The 75th percentile reduction percentage[40] calculated independently for each month (i.e., the value for each month that is exceeded in 25% of all years simulated) and the present-day level of a company's rate of withdrawal are used in section 3.3.2 to define company-specific Freshwater Quantity targets. Section 3.3.6 provides a hypothetical example demonstrating how a company (Ursus Nourishment) would use results from Equation 1 to calculate a 75th percentile reduction percentage and Freshwater Quantity targets.

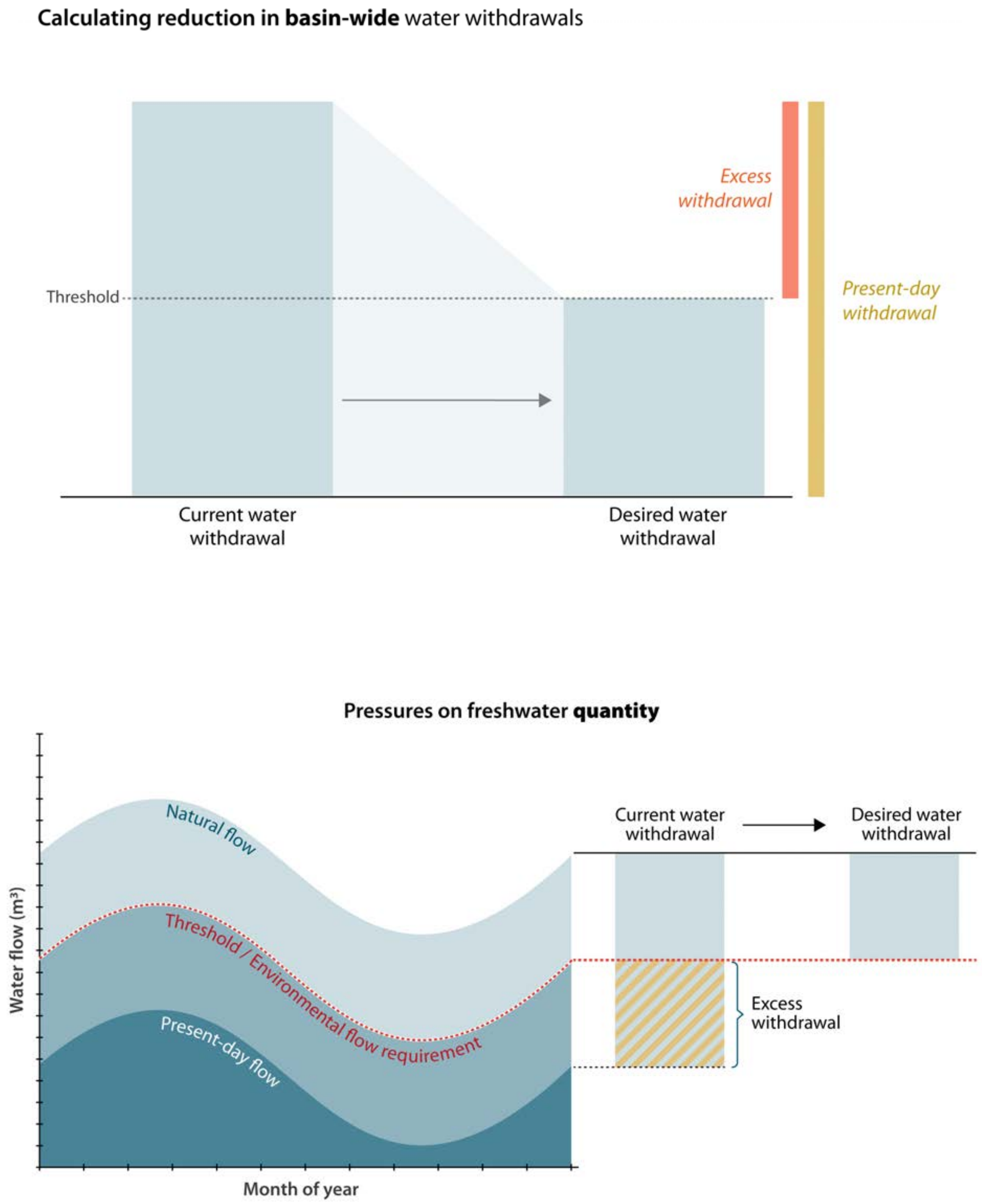


Figure 6— These illustrations show the relationship between current and desired levels of water withdrawals. The first image shows how these variables are used to calculate the required reduction for the targets. The second image in the figure, where the desired water withdrawals are identified as the environmental flow requirements, includes a third variable: natural flows in the basin; and shows their seasonal variability over the course of a year.

Globally developed modeling approach
Globally developed Freshwater Quantity targets *must* be defined using the results from Hogeboom's water quantity global model[28] to define the required reduction percentage in basin-wide withdrawals that will attain the desired stream flows.[41]

The approach is similar to that described for the locally developed approach, where the required reduction percentage is based on the ratio of excess withdrawals to present-day withdrawals (i.e., Equation 1). The difference is that the globally developed approach uses the results of global hydrologic models to calculate excess and present-day withdrawals rather than locally developed data and therefore may reflect an over- or underestimation of actual water scarcity/availability conditions. As discussed below, all technical steps are being automatically conducted within the model framework such that a company only needs to specify the basin(s) of interest, and the required basin-wide reduction will be provided.

Hogeboom et al. (2020) estimated natural stream flow by extracting results from three global hydrologic models[42] to define ensemble mean monthly flow regimes for streams worldwide in the absence of any withdrawals. They determined e-flow requirements based on the ensemble mean results of three widely accepted methods[43] for establishing e-flow requirements to be set aside in each basin to ensure proper aquatic ecosystem functioning on a monthly basis. They then calculated the amount of water available for human use by subtracting e-flow requirements from natural flow regimes, for each basin in the world and for each month in the period 1970–2005.

Hogeboom's water quantity global model[28] is updating the above analysis to calculate the required reduction percentage at the basin level for each month of the period 1971–2010 using Equation 1, and subsequently to define the percentage reduction required for each month such that e-flow requirements would be attained approximately 75% of the time.[44] These results will be provided for each Pfafstetter Level 5 basin worldwide in an easy-to-use format by the time of the public release of the final V1 Freshwater target-setting method in 2023. These reduction percentages are to be used as the basis for target-setting if the globally developed approach is taken using the Hogeboom model.

3.3.2 DETERMINE COMPANY-SPECIFIC FRESHWATER QUANTITY TARGET

Section 3.3.1 explains how a company calculates the basin-wide reductions in water withdrawals needed in order to meet environmental and social requirements. Once the company has determined this value (on both a yearly and a monthly basis for each site targeted), it then defines a target level for its individual withdrawals, consistent with the maximum allowable level of basin-wide withdrawals defined above.

The conversion of allowable basin-wide withdrawals into individual company-specific targets requires a decision on how the water pressure reduction burden will be shared among water users. For methods developed by SBTN, the determination of individual contributions[45] within the context of a societal goal (e.g., water flows that meet environmental needs) is referred to as **allocation**. Many different approaches are available for determining a company's share of an allocated resource or allocated responsibility for action.

For this target-setting method, the allocation approach called "equal contraction of efforts" is used.[46] This approach assumes that all water users in the basin will reduce their withdrawals by the same percentage.

Companies can take the results from Equation 1 (for the locally developed back-calculation from existing results approach) or from Hogeboom (for the globally developed approach) and convert these into the individual company's maximum amount of withdrawals (in terms of volume per time, such as ML/month) that will (through equal contraction of withdrawals, by all actors within the basin) attain the desired state of nature (Equation 2). To convert basin-wide allowable withdrawals to company-specific allowable withdrawals, companies can multiply the required basin-wide percentage reduction with the company's present-day level of withdrawal (in the same units of volume per time):

$$\text{Company target withdrawal} = \frac{100 - \text{\% reduction in basin-wide withdrawal}}{100} \times \text{Present-day company withdrawal}$$

Equation 2

Box 1—Freshwater Quantity targets and the AWS Standard

Criteria 2.3.2 of the AWS Standard requires sites to develop a water stewardship plan that addresses water risks, opportunities, and shared challenges at the basin level. The plan must include specific targets for each of the water stewardship outcome areas, including water quantity. This method for setting SBTs for freshwater quantity offers a robust way of developing water quantity targets for sites implementing the AWS Standard.

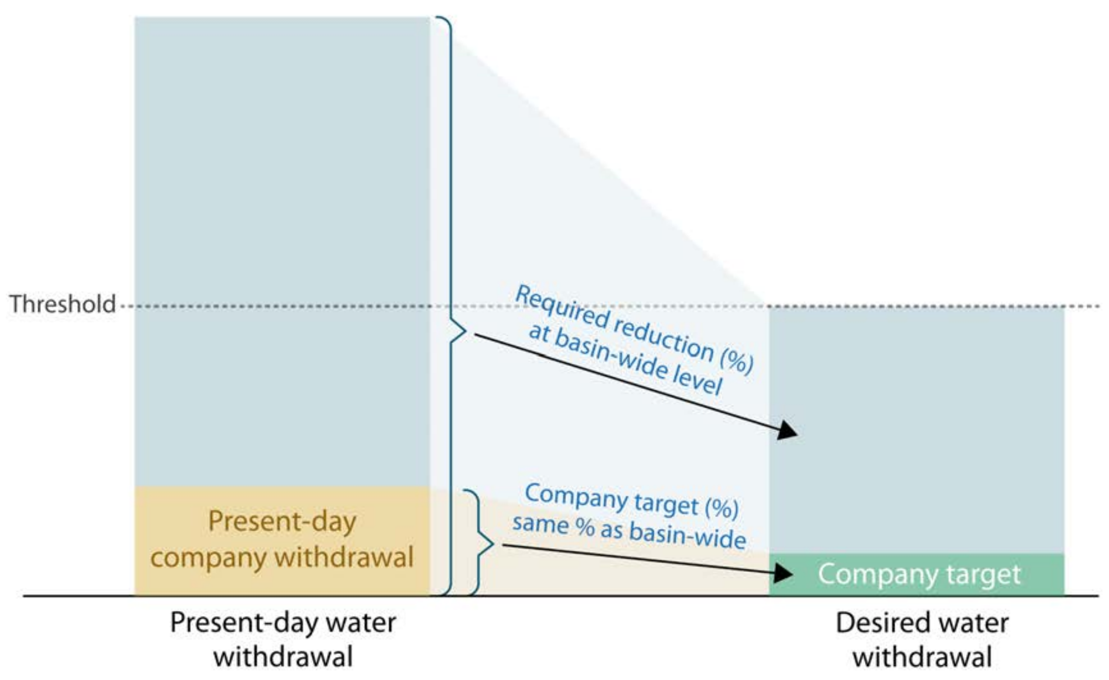

Calculating reduction in **company-specific** water withdrawals

Figure 7 – This figure shows the relationship between a company's individual shares of current and desired withdrawals relative to the total withdrawals in the basin. The same percentage required in the total withdrawals is applied to the company's individual withdrawals, to calculate their targets.

The allocation approach of "equal contraction of efforts" effectively gives every stakeholder the same level of reduction ambition, defined as a percentage, relative to its starting position (i.e., the moment when the stakeholder calculates its baseline). This allocation approach was chosen for its simplicity, as the only input data required is the baseline level of an individual company's impacts. For practical reasons, this version of the methodology does not address potential allocation factors such as social, economic, technological, or political aspects.

The equal contraction of efforts approach has the potential to penalize companies that are leading on water withdrawal reduction ambitions *before* calculating the baseline. To help mitigate this problem, companies should define their baseline, taking the last five years of impacts into account. Future iterations of this methodology will consider other allocation approaches to deal with the known limitations of equal contraction of efforts (e.g., locking in an unfair share for users that have been using a greater proportion of the resource).

3.3.3 TIMESTEP FOR FRESHWATER QUANTITY TARGETS

Companies *may* use annual or monthly time periods for their **surface** Freshwater Quantity targets, dependent on their baselining methodology:

- When baselines were calculated with annual values, the targets *must* be expressed as annual reductions.
- When baselines were calculated with monthly values, the targets may be expressed as monthly or annual reductions. If companies set their targets on an annual basis, the required reduction *must* be equal to the largest reduction required across all individual months. For example, if the required reductions are 50% for certain months of the year and zero for other months, a company *could* set targets on an annual basis requiring a blanket 50% reduction across the entire year. See Tables 4 and 5 for an example of this.

  The decision to use monthly vs. annual targets will likely depend on the type of company setting targets. For example, agricultural irrigation withdrawals that vary widely on a seasonal basis may be better suited to monthly targets than some types of direct operations whose water withdrawals are relatively constant over the course of the year.

Freshwater Quantity targets based on **groundwater** levels *should* be specified on an annual basis.

3.3.4 TEMPLATE STATEMENT FOR FRESHWATER QUANTITY TARGETS

Companies *must* submit their targets with a target year of five years from the date that the target is submitted. This target length balances the urgent need for progress on freshwater quantity in line with global goals and provides companies sufficient time to implement actions to reduce their pressures.

When setting annual targets, the target will be stated as "Company X will reduce its water withdrawal in the ______ basin to ______ ML/year by the year ______."

When setting monthly targets, the target will be stated as "Company X will reduce its water withdrawal in the ______ basin to ______ ML/month for each of the following months. The reductions will occur by the year ______."

3.3.5 VALIDATION CRITERIA FOR FRESHWATER QUANTITY TARGETS

Model selection process

- Models and thresholds are *required* to be developed by an authorized basin agency or otherwise endorsed by three or more types of stakeholder groups, following the criteria in the model selection process laid out in section 3.1.1. An authorized basin agency is a national, regional, state, or local government agency that has the authority to make decisions on the allocation of water resources. Examples include basin management authorities, water resource management agencies, and catchment councils.
- Documentation is *required* to be provided to demonstrate that, in the opinion of the stakeholders consulted in the model selection process, the model used to set targets meets most of the appropriateness criteria laid out in section 3.1.1.

Locally developed modeling approach

- The spatial domain (i.e., basin) for taking a baseline pressure measurement and for setting targets is *required* to be consistent/compatible with the spatial scale defined in the model following the criteria in Section 3.2.1.
- For the baseline pressure measurement at each basin, companies are *required* to identify all of their operations (direct and upstream) that materially affect water availability, as defined in Step 1: Assess.
- For the baseline pressure measurement at each basin, baseline water withdrawals *must* be aggregated across all company operations, using the last five years (or period of existence, if less than five years) of data.
- Baseline values *must* be calculated and recorded separately for direct operations and upstream activities, following the criteria in Section 3.2.2.
- Baseline values based on primary data *must* be calculated and recorded separately from those based on secondary data, following the criteria in Section 3.2.2.

- The specified percentage reduction in basin-wide withdrawals *must* be calculated in one of the following ways (see section 3.3.1 for details on when to apply each approach):
    - Using basin-wide percentage reductions as calculated using Equation 1 (if using the back-calculation approach).
    - Using a hydrologic model and allocation scheme approved by an authorized basin agency to demonstrate that the level of withdrawal used to set the company's targets complies with local e-flow requirements (if using the direct application of model approach).
- Targets for company-specific withdrawals *must* be calculated using Equation 2 and specified in terms of maximum water extraction in terms of volume of water per time, to be achieved within a specified time frame.

Globally developed modeling approach

- The spatial domain (i.e., basin) of the target is *required* to be consistent/compatible with Pfafstetter Level 5—the spatial scheme provided by the *Hogeboom's water quantity global model*[28].
- All company activities in direct operations or upstream that materially affect freshwater quantity in the spatial domain *must* be identified.
- Baseline water withdrawals *must* be defined for each activity, using the last five years (or period of existence, if less than five years) of data.
- The specified percentage reduction in basin-wide withdrawals *must* be calculated using results for the basin provided by *Hogeboom's water quantity global model*[28].
- Targets for company-specific withdrawals *must* be calculated using Equation 2 and specified according to maximum water extraction in terms of volume of water per time, within a specified time frame.

3.3.6 HYPOTHETICAL EXAMPLES OF SETTING FRESHWATER QUANTITY TARGETS

This section provides hypothetical examples of how Ursus Nourishment would set Freshwater Quantity SBTs using both the locally and globally developed modeling approaches. Ursus Nourishment is a fictional food and beverage producer that specializes in plant-based drinks and food. The hypothetical data comes from the SBTN case study In Step 1: Assess and Step 2: Interpret & Prioritize. Based on Steps 1 and 2, Ursus analyzed materiality, value chain pressures, and state of nature. Commodity target boundaries were determined for climate change, land use, land-use change, water use, soil pollution, and water pollution. The following hypothetical examples will focus on water use for two of the top three priority sites within the target boundary (in France and Spain) identified at the end of Step 2. Please consult the standalone case study document for more information.

Locally developed modeling approach

After consulting the SBTN model database (once available), Ursus Nourishment determines that local e-flow requirements and results from a locally developed model are available for the basin from which Ursus Nourishment sources water for growing non-perennials in Spain. Ursus, therefore, chooses to set a Freshwater Quantity SBT using these tools and the back-calculation from the existing results approach. Ursus begins by calculating the cumulative pressures of its operations over the spatial domain considered in the model. One facility directly monitors its water use for irrigation, withdrawing water at a rate of $10x10^6$ ML/month.

Existing e-flow requirements had been specified in the locally developed model on a monthly basis. Hydrologic model results were available, representing the natural stream flow regime and the present-day stream flow regime, and were compiled into monthly averages. These values are shown in Table 3 for a single year, along with the required reduction percentage for each month, calculated using Equation 1. For the example year depicted in Table 3, no reductions are required for 10 months of the year because present-day stream flows exceed e-flow requirements for those months.

The final step in this example is to repeat the calculations in Table 3 for each year in the period of simulation and rank the required reduction percentage by month and year as shown in Table 4. The rank of the 75th percentile reduction percentage is calculated based on the length of the simulation as:

> *75th percentile rank = 0.75 * (Number of years evaluated + 1)*

For this example simulation of 40 years, the 31st-highest reduction percentage corresponds to the 75th percentile. Ursus decides to choose a single annual target, so it bases it on the most stringent 75th percentile monthly reduction in Table 4 (39%). Application of Equation 2 indicates that, with a present-day pressure of $10x10^6$ ML/month and a required reduction of 39%, Ursus has a target of $6.1x10^6$ ML/month for its facility. (Alternatively, Ursus could have specified monthly targets using each month's 75th percentile reduction percentage in Equation 2.)

Globally developed modeling approach

For the basin in which Ursus Nourishment grows crops in France that was prioritized at the end of Step 2: Interpret & Prioritize, Ursus determines that no site-specific hydrologic model or local e-flow requirements have been developed following stakeholder engagement. Ursus, therefore, chooses to set a Freshwater Quantity target using a globally developed approach. Ursus determines that it has a single supplier located in the basin defined by Hogeboom et al. (2020) with a calculated blue-water footprint of $72x10^6$ ML/year. Ursus takes the required annual reduction percentage from the database to be provided by Hogeboom et al, which for this hypothetical example is 34%.

Application of Equation 2 indicates that its SBT for Freshwater Quantity with a present-day withdrawal of $72x10^6$ ML/year and a required reduction of 34% results in a target of $47.5x10^6$ ML/year.

Table 3—Local environmental flow requirements and model-predicted flows by month for a single hypothetical example year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Environmental flow requirement ($x10^{-6}$ ML/month)	64	146	152	136	120	104	75	54	42	49	58	65
Natural stream flow ($x10^{-6}$ ML/month)	80	183	190	170	150	130	93	67	52	61	72	81
Present-day stream flow ($x10^{-6}$ ML/month)	70	173	180	160	140	115	78	52	37	51	62	71
Required reduction in withdrawal (%)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	11%	31%	n/a	n/a	n/a

Table 4—Reduction percentages for 40-year period of record, ranked independently for each month.

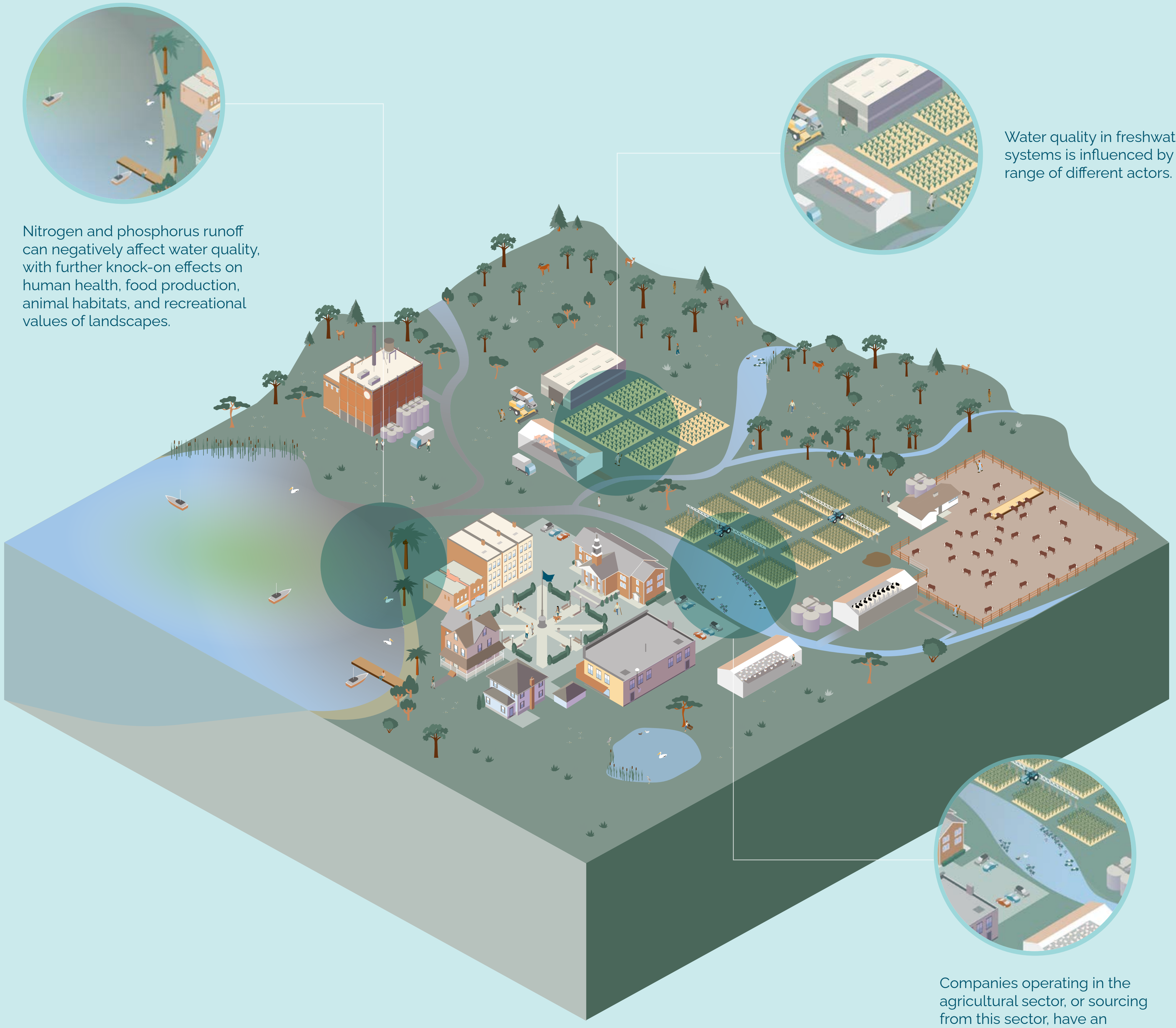
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rank	**Required reduction in withdrawal (%)**											
1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%	3%	5%	0%	0%	0%
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
31	0%	0%	0%	0%	0%	0%	5%	20%	39%	8%	0%	0%
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
39	2%	5%	9%	13%	16%	21%	26%	31%	59%	27%	9%	1%
40	3%	6%	11%	15%	18%	24%	29%	54%	68%	35%	14%	2%

Figure 8 – Freshwater quality targets

SBTs for freshwater quality focus on pressures associated with loads of nitrogen (N) and phosphorus (P) to surface water bodies. Toxic chemicals and other freshwater quality parameters will be developed in future iterations.

Companies that can influence N and P concentration levels within a basin are key actors that should consider setting a water quality target.

V1 Freshwater quality targets will address point source and nonpoint source pollution. Different types of data will be needed depending on whether the target is managing a company's direct operations or upstream impacts.



Nitrogen and phosphorus runoff can negatively affect water quality, with further knock-on effects on human health, food production, animal habitats, and recreational values of landscapes.

Water quality in freshwater systems is influenced by a range of different actors.

Companies operating in the agricultural sector, or sourcing from this sector, have an important role to play in setting these targets to reduce pressures and improve ecosystem health.

3.4 Setting Freshwater Quality targets

Target-setting for freshwater quality follows a similar process to the process described for freshwater quantity (section 3.3). After companies have calculated freshwater quality baseline values for all priority sites in a given basin, they can begin to define targets for freshwater quality for direct operations and upstream activities. To set targets, companies *must* next calculate the maximum allowable load of nutrients for all nutrient sources in a basin and then define the portion of that amount of pollution (at the basin level) to be allocated to the company's operations. Target-setting concludes by allocating a portion of this amount to the company's operations. Targets are to be set for each basin in which priority sites have been identified in Step 2: Interpret & Prioritize.

Note that this section is designed to produce results that are at the upper limit of what would be acceptable, such that there is no buffer built in as a margin of error. Ideally, a company would be more ambitious than these targets (i.e., set a Freshwater Quality target that aims at reducing nutrient loads more drastically than what is to be required through the targets). In that case, companies *must* submit the target value as determined using the SBTN methods but are *recommended* to also provide information on their more ambitious target value and its rationale.

3.4.1 MAXIMUM ALLOWABLE LEVEL OF BASIN-WIDE NUTRIENT LOAD

Locally developed modeling approach
Under this step, the company applies a method to relate the magnitude of nutrient loads within a basin to the resulting freshwater quality within that spatial domain in order to then determine the maximum amount of basin-wide nutrient load that will be within the specified freshwater quality threshold. Two options exist for calculating the maximum allowable level of nutrient loads for the locally developed modeling approach:

- *Direct application of model:* This option provides more flexibility in terms of the use of freshwater quality indicators other than nutrient concentration, but it requires the application of the locally developed model to explicitly demonstrate that the proposed nutrient load target will result in attainment of freshwater quality consistent with the threshold concentration representing the desired freshwater quality.

  It is most suited for situations where it is feasible to conduct new applications of the local model and where thresholds for parameters other than nutrients are relevant.

- *Back-calculation from existing results:* This option provides specific equations for calculating allowable loads using the information on existing recognized nutrient thresholds and model results for present-day nutrient concentration. It allows targets to be set without requiring a new application of the locally developed model but lacks flexibility for considering factors such as nutrient-related freshwater quality thresholds specified in terms other than nutrient concentration (e.g., chlorophyll a, dissolved oxygen).

  It is most suited for situations where it is not feasible to conduct new applications of the local model and/or where thresholds for parameters other than nutrients are not relevant.

Direct application of model
The direct application of model option for defining the maximum allowable nutrient load applies in cases where a locally developed model and freshwater quality thresholds are available to be applied for purposes of evaluating specific reduction scenarios. For this option, the company defines its maximum allowable level of nutrient load by demonstrating with model results that the desired instream nutrient concentration will be attained for the targeted level of nutrient load over the entire period of simulation. This option avoids the simplifying assumption of the back-calculation from existing results approach that nutrient concentrations are proportional to nutrient loads. It also allows for targets to be set considering freshwater quality endpoints (e.g., chlorophyll a, dissolved oxygen), which reflect the impact of nutrient pollution rather than the instream nutrient concentration.

Back-calculation from existing results
The back-calculation from existing results method provides specific equations for calculating the maximum amount of nutrient load (in terms of mass per time, such as kg/year) that will attain the desired instream nutrient concentration. It is based on the assumption that instream nutrient concentrations at any given time are directly proportional to the rate of nutrient loading (e.g., Preston et al., (2011)). This assumption allows the required basin-wide reduction in load to be directly calculated from the output of the freshwater quality model representing present-day nutrient concentrations (which will be provided by essentially all locally developed models) and the threshold nutrient concentration, thus representing the maximum concentration consistent with the desired state of nature.

The extent to which basin-wide nutrient loads must be reduced to meet the desired nutrient concentration is based on the same concept of comparing the ratio of excess pressure to present-day pressure described above for Freshwater Quantity SBTs. For quality, pressures are expressed as nutrient concentration (by assuming a proportional relationship between loads and concentrations), as illustrated by the following equation:

$$\boxed{\text{\% Required reduction in Basinwide Nutrient load} = \frac{\text{Current Nutrient Concentration} - \text{Threshold Nutrient Concentration}}{\text{Current Nutrient Concentration}}}$$

Equation 3

Equation 3 is applied over the entire time period of existing locally developed model results to determine the 75th percentile largest individual required reduction percentage. Note that the temporal resolution of the threshold nutrient concentration may vary by basin (e.g., specified as an instantaneous never-to-be-exceeded value, as a seasonal average, or as an annual average) and that the temporal resolution required for this assessment should be consistent with the temporal resolution considered by the threshold. The percentage reduction provided by Equation 3 is used in the next step in conjunction with the present-day level of nutrient loads to define company-specific Freshwater SBTs.

Globally developed modeling approach
For globally developed Freshwater Quality targets, the company uses results from a global freshwater quality model to define the maximum amount of nutrient load that will attain the desired instream nutrient concentration. The required percentage reduction in nutrient loads for globally developed targets is based on results from the modeling work described in McDowell et al. (2020).[47] Based on global models of N and P concentrations using data from thousands of sites sampled worldwide between 1990 and 2016, their work defined:

- Present-day median growing season total N and total P concentrations for basins worldwide.
- Which nutrient (N or P) is the **limiting factor** (i.e., in the lowest supply relative to needs) for algal growth in each basin. They determined the limiting nutrient by comparing the predicted N:P ratio with the Redfield ratio (Redfield et al., 1963) of 7 (as specified on a mass basis; predicted N:P ratios greater than 7 were taken as an indicator of P limitation, whereas N:P ratios less than 7 were taken as an indication of N limitation).
- That global concentration threshold values for total N (0.70 mg-N/L) and total P (0.046 mg-P/L) represent acceptable levels of algal growth. These concentrations were based on a literature review of studies defining local N and P thresholds related to periphyton growth.

The extent to which basin-wide loads must be reduced in order to meet the desired state of nature is based on Equation 3, described above for the locally developed approach. All the data required to apply Equation 3 can be obtained from McDowell et al. (2020).[48] Note that Equation 3 is applied only to the basin-specific limiting nutrient as identified by McDowell et al. (2020). Section 3.4.6 provides a hypothetical example demonstrating how results from McDowell et al. (2020) are used to calculate Freshwater Quality targets.

3.4.2 ALLOCATION APPROACH

At this point in the process, the company defines a target level for its nutrient loads, consistent with the maximum allowable basin-wide load defined above. This is accomplished by multiplying the required percentage reduction (as calculated either via Equation 3 or via a direct application of model approach) with the present-day nutrient load:

$$\textit{Company target load} = \frac{100 - \textit{\% Reduction in basin-wide load required}}{100} \; x \; \textit{Present-day company load}$$

Equation 4a

$$\textit{Company target grey water footprint} = \frac{100 - \textit{\% Reduction in basin-wide load required}}{100} \; x \; \textit{Present-day grey water footprint}$$

Equation 4b

The targets set using Equation 4a or 4b, depending on the units used, assume the same “equal contraction of efforts” allocation approach as described earlier for freshwater quantity in section 3.3.2.

3.4.3 TIMESTEP FOR FRESHWATER QUALITY TARGETS

Companies *can* use annual or finer (e.g., seasonal) time periods for their targets, but the selected percentage reduction reflected in the target *must* be consistent with the most stringent required reduction. For example, if the threshold nutrient concentration applies only to the summer growing season and the required reductions are 25%, companies *can* set targets on an annual basis, but they will be *required* to achieve a blanket 25% reduction across the entire year. Companies *may* also set targets on a seasonal basis, when the local basin authority specifies a growing season (e.g., May–September in the Northern Hemisphere), and require reductions only for those months where the threshold concentration is applicable.

3.4.4 TEMPLATE STATEMENT FOR FRESHWATER QUALITY TARGETS

Depending on the method and units of measurement used to calculate pressures, Freshwater Quality targets will be stated in the following forms. Note that companies must set separate Freshwater Quality targets for N and P when targets for both are required. Companies *must* submit their targets with a target year of five years from the date that the target is submitted. This target length balances the urgent need for progress on freshwater quality in line with global goals and provides companies sufficient time to implement actions to reduce their pressures.

- When setting targets on an annual basis, using direct or secondary measurement (with units of nutrient load), targets will be stated as “Company X will reduce its nutrient load in the _____ basin to _____ kg P (or N)/year by the year _____.”
- When setting targets on a seasonal basis, using direct or secondary measurements (with units of nutrient load), targets will be stated as “Company X will reduce its nutrient load in the _____ basin to _____ kg P (or N)/month for each of the following months. The reductions will occur by the year _____.”
- When setting targets on an annual basis, using gray-water footprint(s), targets will be stated as “Company X will reduce its gray-water footprint in the ______ basin to _____ ML/year by the year _____.”

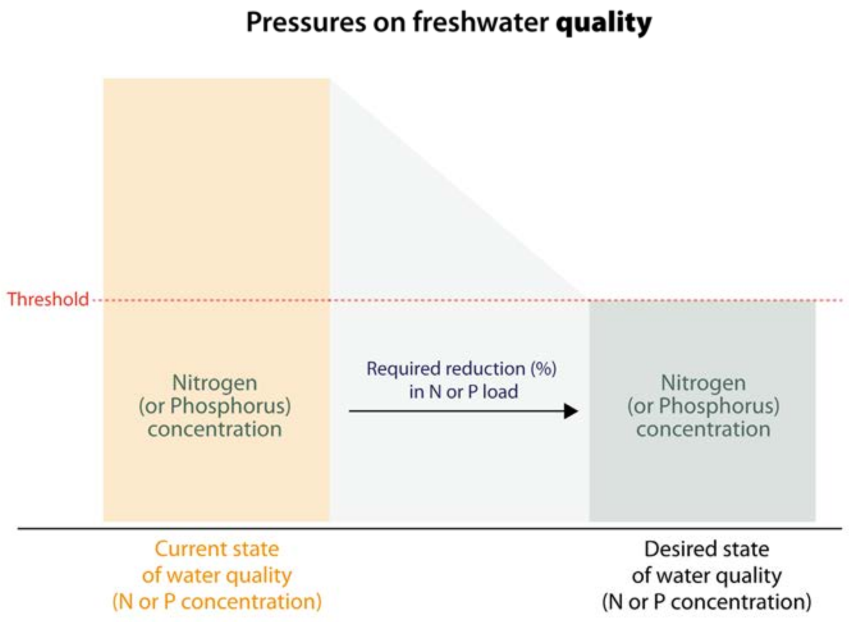


Figure 9 – Pressures on freshwater quality. This illustration shows the relationship between current and desired levels for water quality pressures in the basin (either Nitrogen or Phosphorus).

Box 2: Freshwater Quality targets and the AWS Standard

> Criteria 2.3.2 of the AWS Standard requires sites to develop a water stewardship plan that addresses water risks, opportunities, and shared challenges at the basin level. The plan must include specific targets for each of the water stewardship outcome areas, including water quality. This method for setting SBTs for freshwater quality offers a robust way of developing water quality targets for sites implementing the AWS Standard.

3.4.5 VALIDATION CRITERIA FOR FRESHWATER QUALITY TARGETS

Model selection process

- Models and thresholds are *required* to be developed by an authorized basin agency or otherwise endorsed by three or more types of stakeholder groups, following the criteria in the model selection process laid out in section 3.1.1. An authorized basin agency is a national, regional, state, or local government agency that has the authority to make decisions on the allocation of water resources. Examples include basin management authorities, water resource management agencies, and catchment councils.
- Documentation is *required* to be provided demonstrating that, in the opinion of the stakeholders consulted in the model selection process, the model used to set targets meets most of the appropriateness criteria laid out in section 3.1.1.

Locally developed modeling approach

- The spatial domain (i.e., basin) of the target is *required* to be consistent/compatible with the spatial scale used in the model following the criteria in Section 3.2.1.
- For the baseline pressure measurement at each basin, companies are *required* to identify all of their operations (direct and upstream) that materially affect water quality, as defined in Step 1: Assess.
- Baseline nutrient loads *must* be defined for each operation, using the last five years (or period of existence, if less than five years) of data.
- Baseline values *must* be calculated and recorded separately for direct operations and upstream activities, following the criteria in section 3.2.2.
- Baseline values based on primary data *must* be calculated and recorded separately from those based on secondary data, following the criteria in section 3.2.2.
- The specified required percentage reduction in basin-wide pollution loads *must* be calculated in one of the following ways:
  - Taken from the model application, if available;
  - Using Equation 3 or the direct application of model approach as described in section 3.4.1.
- Targets for company-specific pollution load reduction *must* be calculated using Equation 4 and specified in terms of maximum nutrient load in terms of mass of nutrient per time, within a specified time frame.

Globally developed modeling approach

The validation criteria for globally developed Freshwater Quality SBTs consist of ensuring the following:

- The spatial domain (i.e., basin) of the target was explicitly identified at Pfafstetter Level 4—the spatial scheme provided by McDowell et al. (2020).
- All company operations (direct and upstream) that materially affect freshwater quality in the spatial domain were identified.
- Baseline nutrient loads were defined for each operation, using the last five years (or period of existence, if less than five years) of data.
- The specified required percentage reduction in basin-wide loads was calculated using Equation 3.
- Targets were calculated using Equation 4 and specified according to maximum nutrient load in terms of mass of nutrient per year, within a specified time frame.

3.4.6 HYPOTHETICAL EXAMPLES OF SETTING FRESHWATER QUALITY TARGETS

This section provides hypothetical examples of how Ursus Nourishment would set Freshwater Quality SBTs using both the locally developed and globally developed approaches, focusing on water pollution for two of the top three priority sites within the target boundary (in France) identified at the end of Step 2: Interpret & Prioritize. Please see section 3.3.6 or the standalone Ursus Nourishment case study for more information on the company.

Locally developed modeling approach

After consulting with national and local stakeholders, Ursus Nourishment determines that a local nutrient threshold and results from an approved freshwater quality model are available in the basin containing its manufacturing and packaging activities in France. Ursus therefore chooses to set a Freshwater Quality target using these tools and the back-calculation from existing results approach. The spatial domain of Ursus' assessment is defined by the scale of the local model, which was Pfafstetter Level 5. Ursus begins by calculating the cumulative pressures of its operations over the spatial scale considered in the model. One facility directly monitors its nutrient discharges to the basin. Both facilities used primary data on their discharge flow rate and effluent P concentration to calculate their P load. One facility discharges P at a rate of 5 kg P/month, and the second facility discharges P at a rate of 3 kg P/month. The sum of these two numbers results in a cumulative P load of 8 kg P/month.

The company has access to results from the freshwater quality model but does not have the resources to conduct additional model simulations. For this reason, it uses the back-calculation from existing results approach, which combines existing model results with information on the freshwater quality threshold, to define the required reduction percentage. The local nutrient threshold is specified by the basin authority as a seasonal (May through September) average P concentration of 0.1 mg/L, as shown in the first row of Table 6. Freshwater quality model results were available, representing the monthly instream nutrient concentration associated with present-day nutrient load over a 20-year period of historical stream flows. These values are shown in the second row of Table 6 for a single year of simulation. The third row of Table 6 converts each of the five monthly average concentrations into a single May–September average, to allow direct comparison with the time period specified by the threshold.

The final row of Table 6 applies Equation 3 to calculate the required reduction percentage for the May–September period. For the example year depicted, existing nutrient loads must be reduced by 33% (i.e., [0.15 - 0.10]/0.15) to meet the seasonal average threshold.

Table 6—Freshwater quality nutrient threshold and model-predicted flows by month and season for a single hypothetical example year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Threshold P concentration (mg P/L)	n/a	n/a	n/a	n/a			0.10			n/a	n/a	n/a
Present-day P concentration (mg P/L)	0.12	0.13	0.11	0.11	0.14	0.14	0.15	0.16	0.16	0.14	0.14	0.13
May–September P concentration (mg P/L)	n/a	n/a	n/a	n/a			0.15			n/a	n/a	n/a
Required reduction in withdrawal (%)	n/a	n/a	n/a	n/a			33%			n/a	n/a	n/a

The final step in this example is to repeat the calculations in Table 6 for each year in the period of simulation and rank the required reduction percentage by year as shown in Table 7. The rank of the 75th percentile reduction percentage is calculated based on the length of the simulation as:

> *75th percentile rank = 0.75 * (Number of years evaluated + 1)*

For this example simulation of 20 years, the 16th-highest reduction percentage corresponds to the 75th percentile, indicating a required nutrient load reduction of 35%. Application of Equation 4 indicates that with a present-day pressure of 8 kg/month and a required reduction of 35%, Ursus has a target of 5.2 kg/month for its aggregate load across all facilities. Because the nutrient threshold applies only during the May–September period, Ursus has the option of meeting the target only for the May–September period or for the entire year.

Rank	Required reduction in load (%)
1	0%
2	3%
⋮	⋮
16	35%
⋮	⋮
19	41%
20	43%

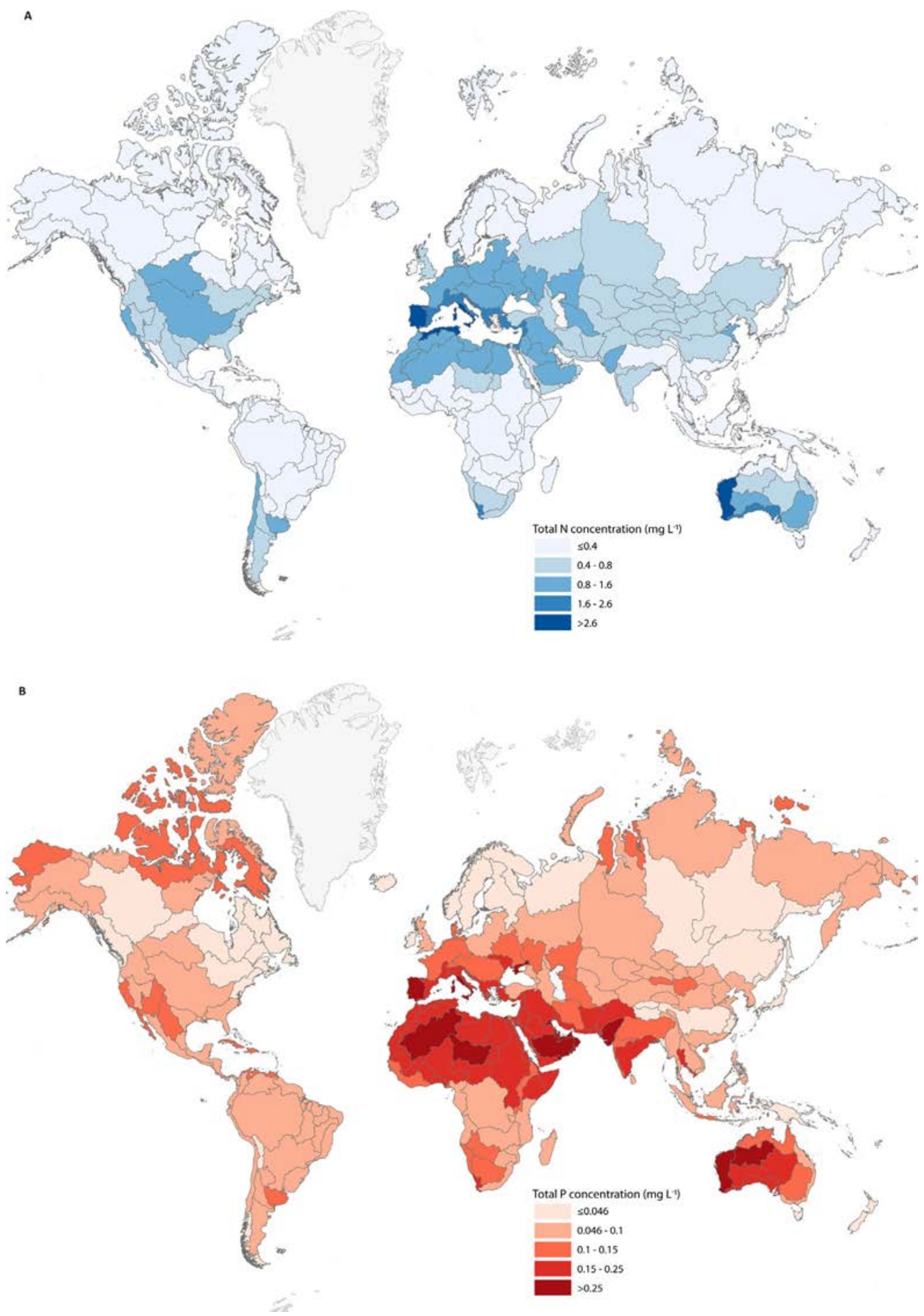


Figure 10—Modeled total N (A) and total P (B) concentrations (mg/L) from McDowell et al. (2020).

Globally developed modeling approach
Following stakeholder engagement, Ursus determines that no site-specific freshwater quality model or local nutrient concentration thresholds have been developed in the basin where it grows crops in western France. Ursus, therefore, chooses to set a Freshwater Quality target using a globally developed approach. Ursus uses primary data (collection of data from channels where their runoff exits their farm fields) to determine that the farm fields discharge N at a rate of 71 kg/year and P at a rate of 11 kg/year. The company extracts site-specific information on present-day nutrient concentrations and the limiting nutrient from the maps provided by McDowell et al. (2020), shown in Figures 10 and 11 (until the updated database is available).

These values are as follows:

- N concentration range from Figure 10 is 0.8 to 1.6 mg/L, so a midpoint value of 1.2 mg/L is selected.
- P concentration range from Figure 10 is 0.1 to 0.15 mg/L, so a midpoint value of 0.125 mg/L is selected.
- Limiting nutrient from Figure 11 is P.

Ursus consulted its farm manager and received confirmation that P is the limiting nutrient at all times and locations, such that no reductions were required for N. Because P is the limiting nutrient, the company applies Equation 3 to define the required reduction percentage using the site-specific predicted median growing season total P concentration of 0.125 mg/L and the global P threshold provided by McDowell et al. (2020) of 0.046 mg/L. The required reduction percentage is 63% ([0.125 – 0.046] ÷ 0.125).

Globally developed Freshwater Quality targets are specified on an annual basis, so the application of Equation 4 indicates that Ursus' SBT for Freshwater Quality for a present-day pressure of 11 kg/year and a required reduction of 63% results in a target of 4.0 kg P/year.

3.4.7 NEXT STEPS FOR COMPANIES WITH VALIDATED FRESHWATER TARGETS

After setting their freshwater science-based targets, companies should start implementation actions and track progress on their pressures, relative to their baselines. Further guidance on Step 4: Act and Step 5: Track is forthcoming,[49] and a preliminary list of response options for Step 4: Act is provided in Appendix A and in the SBTN Initial Guidance. The AWS Standard Version 2.0 is also a useful resource to support companies in creating and implementing water stewardship plans with associated response options that can help sites meet their Freshwater SBTs.

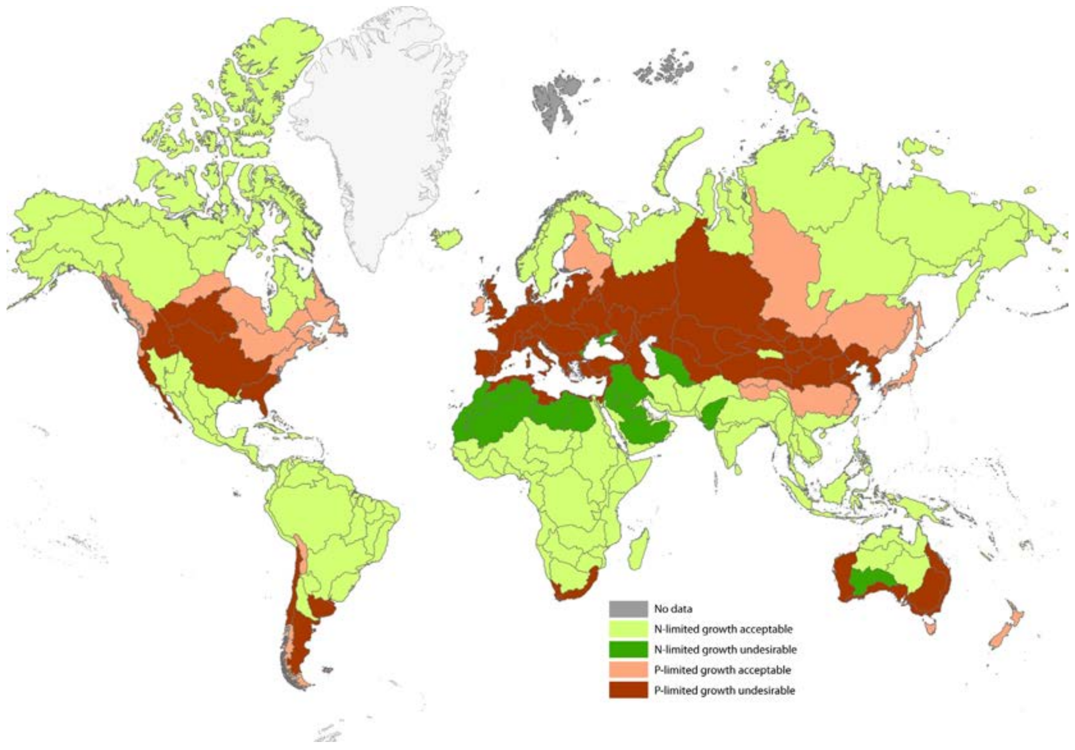


Figure 11—Modeled limiting nutrient from McDowell et al. (2020).

> After setting their freshwater science-based targets, companies should start implementation actions and track progress.

Endnotes

1 See *https://sciencebasedtargets.org/resources/files/SBTi-criteria.pdf*

2 See SBTN Glossary: *https://docs.google.com/document/d/1535elCPG1vsHDIXpVG96w93S4OZ_Fa2n/edit#*

3 Refer to "Science-Based Targets for Nature, Initial Guidance for Business (September 2020)" for a detailed description of the five-step process. For technical guidance, please see the methods for Step 1: Asses and Step 2: Interpret & Prioritize. Guidance for Steps 4 and 5 is anticipated to be published in SBTs for nature v2.

4 A form of water pollution driven by excess levels of nutrients (primarily nitrogen (N) and phosphorus (P).

5 The concept of setting quantitative pressure targets at a level necessary to protect water is not new. It is based on existing accepted approaches to target-setting (e.g., the United States' Total Maximum Daily Loads program).

6 Cite method when ready.

7 Cite method when ready.

8 This tool is under development and will be made available to target-setting companies with new technical developments slated for 2024.

9 Freshwater quantity and/or freshwater quality data collection depends on the water aspects that were prioritized in Step 2: Interpret & Prioritize for a specific basin.

10 If operations or the purchase of a given commodity/reliance on upstream activity have been in existence for less than five years (or have collected data for less than five years), then the time frame should be over the length of existence (or the period of data collection for less than five years). If sourcing locations for commodities have varied over the last five years, then refer to Step 1: Assess and Step 2: Interpret & Prioritize for guidance. However, if the shifts in sourcing locations occurred within the same basin, then the pressure data from each of these locations should be averaged.

11 Water Footprint Network: Water footprints of crops, derived crop products, biofuels, livestock products, and industrial products. All data are available at national and sub-national level. *https://waterfootprint.org/en/resources/waterstat/product-water-footprint-statistics/*

12 Or upstream of the location of withdrawal.

13 Sites that have implemented the AWS Standard should have gathered this data for AWS Indicator 1.3.3.

14 Sites that have implemented the AWS Standard should have gathered this data for AWS Indicator 1.3.4.

15 Further information and reasoning for the importance of taking a local approach when setting Freshwater SBTs can be found *here.*

16 Sites that have implemented the AWS Standard should have already gathered data on basin specific conditions for Criteria 1.5. Basin water quantity and quality data, respectively, should have been collected for AWS Indicators 1.5.3 and 1.5.4.

17 It is expected that end-user resources required for target-setting will decrease in the future as a result of (a) additional SBTN tools to make models more accessible to end users and (b) companies becoming more familiar with both the impacts of their operations and the target-setting methods.

18 Legg T, Hatchard J, Gilmore AB. The science for profit model—how and why corporations influence science and the use of science in policy and practice. PLoS One. 2021 Jun 23;16(6):e0253272.

19 This describes a target that is incentivizing the correct direction of action from baseline to achieve the target, although when more precise and accurate models are used, the target value may be changed.

20 Sites that have implemented the AWS Standard should have identified relevant stakeholders for AWS Indicator 1.2.1. Companies may also choose to conduct an initial literature review of freshwater quantity and freshwater quality modeling in the basin to facilitate the local stakeholder identification process.

21 OECD. 2015. "Stakeholder engagement for inclusive water governance," OECD Studies on Water, OECD Publishing, Paris.

22 For sites that have implemented, or are implementing the AWS Standard, this requirement can be integrated with documentation of the stakeholder identification and engagement process for AWS Indicator 1.2.1.

23 Before this tool is available companies must progress to the next step in the model decision-tree as noted in cases when there is no local model or threshold noted in the basin threshold tool.

24 McDowell, R. W., A. Noble, P. Pletnyakov, B. E. Haggard and L. M. Mosley, 2020. Global Mapping of Freshwater Nutrient Enrichment and Periphyton Growth Potential. Scientific Reports. *https://doi.org/10.1038/s41598-020-60279-w*

25 Sites that have implemented the AWS Standard should have defined their basin level as part of AWS Criteria 1.1.

26 Alliance for Water Stewardship, 2019. AWS Standard Version 2.0 Guidance. *https://a4ws.org/the-aws-standard-2-0/download-the-aws-standard-2-0/*

27 UN Global Compact CEO Water Mandate, Pacific Institute, CDP, The Nature Conservancy, World Resources Institute, WWF, UNEPDHI Partnership Centre for Water and Environment. 2019. Setting Site Water Targets Informed by Catchment Context: A Guide for Companies. *www.ceowatermandate.org/site-water-targets*

28 The Water Footprint Network is currently developing a global database of model results based on the work of Hogeboom et al. (2020). This database will be ready for distribution by the time of public release of the final freshwater target-setting method: *https://tools.waterfootprint.org/sbtn-water-targets/*.

29 Sites that have implemented the AWS Standard should have gathered this data for AWS Indicator 1.3.3.

30 Water use for agricultural commodities' production considers only blue-water footprint (see Glossary for definition) and not the green-water footprint (consumption of water sourced from precipitation and stored in soil as soil moisture).

31 Sites that have implemented the AWS Standard may have gathered this data for AWS Criteria 1.4.

32 Either by month or annually, depending on the spatial resolution selected to set targets.

33 Note that this load represents the mass of a nutrient (N or P) and not the mass of a nutrient-containing compound such as ammonia or bulk fertilizer.

34 Sites that have implemented the AWS Standard may have already gathered the data necessary for these calculations as part of AWS Indicator 1.3.4

35 Nonpoint sources are sources of pollution that are delivered to the receiving water body in a diffuse manner (e.g., runoff from agricultural operations).

36 For sites that have implemented the AWS Standard, some of this data may have already been gathered for AWS Indicators 1.4.1 or 1.4.3.

37 This is the threshold value that represents the desired state of nature (see Section 1.1).

38 This assumption is best made when factors such as groundwater depletion or dam operations are not dominant in affecting the flow regime, as has been documented in some cases (e.g., *Döll et al., 2009*).

39 A period of record of at least 20 years is required to capture interannual variability in precipitation.

40 This percentile was suggested by Hogeboom's water quantity global model as a level that balances ambitious reduction goals with the realization that a certain amount of freshwater must be made available for use[28].

https://tools.waterfootprint.org/sbtn-water-targets/

41 While this version of the methodology mandates the use of Hogeboom as the only acceptable tool for the globally developed modeling approach to freshwater quantity, additional sources of models will be considered (and might be added) in future versions.

42 The global hydrologic models currently being used are H08 (Hanasaki et al., 2008); PCR-GLOBWB 2 (Sutanudjaja et al., 2018); and WaterGAP-2C (Müller Schmied et al., 2016).

43 The methods used to define environmental flow requirements are described in Pastor et al. (2014), Richter et al. (2012), and Smakhtin et al. (2004).

44 The same 75th percentile value is used as for the locally developed approach, with no additional safety factor, consistent with the previously stated objective of balancing ambitious reduction goals with the realization that a certain amount of water must be made available for use.

45 'Contributions' can be reductions in 'negative' actions leading toward undesirable outcomes, like pollution, or 'positive' actions leading toward desirable outcomes like improved ecosystem integrity.

46 Alternative allocation approaches will be considered in future versions of this method.

47 While this version of the methodology mandates the use of McDowell as the only acceptable tool for the globally developed approach to freshwater quality, additional sources of models may be added in the future.

48 McDowell (in preparation) is updating the above analysis to provide improved model predictions. These results will be provided for Pfafstetter Level 4 basins worldwide.

49 Note that progress on a Freshwater Quantity science-based target set with a locally developed modeling approach (guidance will be found in Step 5: Track)—will be based on changes to gross withdrawals, unless an explicit demonstration is provided that any credited return flows are present in the stream at the location, time, and quality that they are being applied. The application of V1 methods will also guide the development of MRV on secondary modeled estimates of nonpoint source pollution using the gray-water footprint and other models of water assimilation used in Freshwater Quality science-based targets.

References

A |

Alliance for Water Stewardship, 2019. AWS Standard Version 2.0 Guidance.
https://a4ws.org/the-aws-standard-2-0/download-the-aws-standard-2-0/

Arthington, A.H., A. Bhaduri, S. E. Bunn, S. E. Jackson, R. E. Tharme, D. Tickner, B. Young, M. Acreman, N. Baker, S. Capon, A. C. Horne, E. Kendy, M E. McClain, N. L. Poff, B. D. Richter and S Ward. 2018. The Brisbane Declaration and Global Action Agenda on Environmental Flows. Front. Environ. Sci., 02 July 2018.
https://doi.org/10.3389/fenvs.2018.00045

H |

Hanasaki, N., S. Kanae, T. Oki, K. Masuda, K. Motoya, N. Shirakawa, Y. Shen, and K. Tanaka. 2008. An Integrated Model for the Assessment of Global Water Resources – Part 1: Model Description and Input Meteorological Forcing. Hydrology and Earth System Sciences 12, no. 4 (2008): 1007-25.
https://dx.doi.org/10.5194/hess-12-1007-2008

Hofste, R., S. Kuzma, S. Walker, E.H. Sutanudjaja, et al. 2019. "Aqueduct 3.0: Updated Decision Relevant Global Water Risk Indicators." Technical Note. Washington, DC: World Resources Institute.
https://www.wri.org/publication/aqueduct-30

Hogeboom, R. J., H. Su, J. Schyns and M. Krol. In preparation. Data and documentation support for Science-Based Targets for Water.

Hogeboom, R. J., D. de Bruin, J. F. Schyns, M. S. Krol, and A.Y. Hoekstra. 2020. Capping Human Water Footprints in the World's River Basins. Earth's Future, 8, e2019EF001363.
https://doi.org/10.1029/2019EF001363

M |

McDowell, R. W., A. Noble, P. Pletnyakov, B. E. Haggard and L. M. Mosley, 2020. Global Mapping of Freshwater Nutrient Enrichment and Periphyton Growth Potential. Scientific Reports.
https://doi.org/10.1038/s41598-020-60279-w

Müller Schmied, H., L. Adam, S. Eisner, G. Fink, M. Flörke, H. Kim, T. Oki, F. T. Portmann, R. Reinecke, C. Riedel, Q. Song, J. Zhang, and P. Döll. 2016. Variations of Global and Continental Water Balance Components as Impacted by Climate Forcing Uncertainty and Human Water Use. Hydrology and Earth System Sciences 20, no. 7 (2016): 2877-98.
https://dx.doi.org/10.5194/hess-20-2877

N |

Natural Capital Coalition, 2016. Natural Capital Protocol.
https://naturalcapitalcoalition.org/natural-capital-protocol/

O |

Oki, T., & Kanae, S., 2006. Global hydrological cycles and world water resources. Science, 313(5790), 1068–1072.
https://doi.org/10.1126/science.1128845

P |

Pastor, A. V., Ludwig, F., Biemans, H., Hoff, H., & Kabat, P., 2014. Accounting for environmental flow requirements in global water assessments. Hydrology and Earth System Sciences, 18(12), 5041–5059.

Preston SD, Alexander RB, Schwarz GE, Crawford CG. Factors Affecting Stream Nutrient Loads: A Synthesis of Regional SPARROW Model Results for the Continental United States. J Am Water Resour Assoc. 2011 Oct;47(5):891-915.

R |

Redfield, A. C., Ketchum, B. H. & Richards, F. A., 1963. In The Sea: Ideas and observations on progress in the study of seas, 2 Vol. 2 (ed M. N. Hill) 554, Interscience.

Richter, B. D., Davis, M. M., Apse, C., & Konrad, C. (2012). A presumptive standard for environmental flow protection. River Research and Applications, 28(8), 1312–1321.

S |

SBTN, 2020. Science-Based Targets for Nature. Initial Guidance for Business.
Science Based Target Network.
https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/09/SBTN-initial-guidance-for-business.pdf

Smakhtin, V., Revenga, C., & Doll, P., 2004. A pilot global assessment of environmental water requirements and scarcity. Water International, 29(3), 307–317.
https://doi.org/10.1080/02508060408691785

U |

UN Global Compact CEO Water Mandate, Pacific Institute, CDP, The Nature Conservancy, World Resources Institute, WWF, UNEPDHI Partnership Centre for Water and Environment, 2019. Setting Site Water Targets Informed by Catchment Context: A Guide for Companies.
http://www.ceowatermandate.org/site-water-targets

V |

Vörösmarty, C. J., P. B. McIntyre, M. O. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S. E. Bunn, C. A. Sullivan, C. Reidy Liermann and P. M. Davies, 2009. Global Threats to Human Water Security and River Biodiversity. Nature 467, 555–561 (2010).
https://doi.org/10.1038/nature09440

W |

Wada, Y., Florke, M., Hanasaki, N., Eisner, S., Fischer, G., Tramberend, S., et al. (2016). Modeling global water use for the 21st century: The Water Futures and Solutions (WFaS) initiative and its approaches. Geoscientific Model Development, 9(1), 175–222.

Wada, Y., D. Wisser, and M. F. P. Bierkens. 2014. Global Modeling of Withdrawal, Allocation and Consumptive Use of Surface Water and Groundwater Resources. Earth System Dynamics 5, no. 1 (2014): 15-40.
https://dx.doi.org/10.5194/esd-5-15-2014

Appendix A: Freshwater Response Options

This is a non-exhaustive list of possible response options companies may consider in their attempt to meet the Freshwater SBTs they have set. Further guidance will be provided in the first release of the methods for Step 4: Act. Many response options have co-benefits not only in terms of water quality and quantity but for land too, for example in terms of quality and quantity as well as for biodiversity, and other realms (e.g. terrestrial). It is important to note that collective action for water stewardship is strongly advised as a means to engage proactively in partnerships and landscape-level initiatives. This is because there are likely to be freshwater-related challenges that cannot be effectively tackled on a company-by-company basis.

The *Alliance for Water Stewardship (AWS) Standard* is a useful resource to support companies in organizing their water stewardship plans that take into account response options that will help achieve science-based targets.

Avoid, Reduce, Regenerate, Restore, Transform (AR^{3}T) classification	Freshwater Response Option	Freshwater Quantity (Target Benefit)	Freshwater Quality (Target Benefit)	No Conversion of Natural Ecosystems (Target Benefit)	Land Footprint Reduction (Target Benefit)	Landscape Engagement (Target Benefit)	SBTi Climate FLAG (Target Benefit)
Avoid	Use of recycled water such that a facility does not need to withdraw water and has no net water consumption	■	🟦	□	🟦	🟦	□
Avoid	Use of treatment effluent and other non-potable water supplies such that a facility does not need to use potable water for production and operations	■	🟦	□	🟦	🟦	□
Avoid	Avoid further water use through efficient use of water through behavior and technology	■	🟦	□	□	🟦	🟦
Avoid	Avoid withdrawals from sensitive ecosystems and limited sources (incl. groundwater)	■	■	□	🟦	■	□
Avoid	Avoid runoff and erosion by building green (vegetation) or gray (barrier) infrastructure along waterways and in the watershed to avoid, reduce, or slow down overland flow and erosion	■	■	□	□	🟦	□
Avoid	Avoid habitat conversion to reduce erosion, to preserve the watershed's ability to store, treat, and deliver water, and to reduce impact to terrestrial and aquatic ecosystems	■	■	■	□	■	🟦
Avoid	Eliminate the use of hazardous chemicals	□	■	□	□	■	🟦
Avoid	Zero liquid discharge of wastewater to the environment	🟦	■	□	□	🟦	□
Reduce	Installation of (or upgrade to existing) wastewater treatment facilities to reduce pollutant loading	🟦	■	□	□	🟦	□
Reduce	Reduce water use (existing or future) through efficient use of water via behavior and technology changes	■	🟦	□	□	🟦	🟦
Reduce	Reduce water-intensive production components	■	🟦	□	□	🟦	□
Reduce	Reduce hard surfaces and/or create pervious surfaces to limit surface runoff and associated erosion within the watershed	■	■	□	□	■	□
Reduce	Reduce point source pollution affecting surface and groundwater sources	🟦	■	□	□	■	□
Reduce	Reduce nutrient runoff by promoting/adopting agricultural best management practices such as regenerative agriculture	■	■	□	🟦	■	🟦
Restore/Regenerate	Rehabilitation of degraded land cover in catchments, to increase infiltration (quantity) and reduce pollutant runoff (quality)	■	■	□	□	■	□

Key: ■ Direct 🟦 Indirect □ Unknown

Avoid, Reduce, Regenerate, Restore, Transform (AR³T) classification	Freshwater Response Option	Freshwater Quantity (Target Benefit)	Freshwater Quality (Target Benefit)	No Conversion of Natural Ecosystems (Target Benefit)	Land Footprint Reduction (Target Benefit)	Landscape Engagement (Target Benefit)	SBTi Climate FLAG (Target Benefit)
Restore/Regenerate	Restoring and managing wetlands and other aquatic habitats to improve water quality and quantity	■	■			■	🟦
Restore/Regenerate	Remediate contaminated land/water in order to restore ecosystem function		■			■	
Restore/Regenerate	Plant/restore native vegetation to improve water quality and quantity in watersheds or along riparian/wetland buffers	■	■			■	🟦
Restore/Regenerate	Remove alien vegetation and aggressive indigenous plant species	■	🟦		🟦	■	
Restore/Regenerate	Restore soil health across different degraded habitats	■	■		🟦	■	■
Restore/Regenerate	Recharge aquifers and groundwater sources through solutions such as managed aquifer recharge	■	🟦		🟦	🟦	
Restore/Regenerate	Restore flow regime/re-establish hydrologic connection (e.g., removing hard structures and barriers such as dams and levees, re-operation of existing dams to better align with natural flow regime, rewetting wetlands and floodplains)	■	■			🟦	
Restore/Regenerate	Implement regenerative agriculture to regenerate degraded agricultural landscapes	■	■		🟦	■	🟦
Restore/Regenerate	Construct treatment wetlands or algal filters to meet water quality and quantity objectives	■	■			■	🟦
Transform	Transform urban landscapes to include created waterscapes (e.g., ponds, rivers, wetlands)	■	■			■	
Transform	Creating policies and guidance that bring about a positive change in water quantity or quality in a company and its impact on the watershed	■	🟦			🟦	
Transform	Transform/replace unsustainable products and practices and expand sustainable product lines	🟦	🟦			🟦	
Transform	Influence designer behavior e.g., reduce water use or reduce nonpoint source pollution when consuming your products	🟦	🟦			🟦	

Key: ■ Direct 🟦 Indirect □ Unknown