NATURAL
CAPITAL
COALITION

Data use in natural capital assessments

Assessing challenges and identifying solutions

Full Report

This report has been produced by the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) on behalf of the Natural Capital Coalition. The authors of this report are Matthew Ling, Annelisa Grigg, Heather Bingham, Leo Murphy, Matt Jones, Jonty Knox and Jack Rossiter (UNEP-WCMC), and Siobhan Stewart (Natural Capital Coalition).

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UN environment WCMC 40 years

Foreword by

Mark Gough, Executive Director, Natural Capital Coalition

Virtually everyone who has undertaken a capitals assessment has raised data as a significant challenge. But they all mean slightly different things – hence the need for this project.

Through a collaborative process we now have consensus on a way to categorize the challenges. Putting them into manageable buckets. We have also been able to identify potential solutions, quick wins, and actions we can take forward together as a community or integrate into other activities.

Importantly, the project has confirmed that the most significant challenge with natural capital data is one of flow. Information is not flowing effectively between the different people involved. It is a problem underpinned by four main barriers: access, infrastructure, quality and capacity.

Ultimately, as we have found in all of our collaborative activities, this comes down to a need for better communication. Therefore our next steps will be to convene those involved to build mutual understanding and co-create solutions.

As with all projects carried out on behalf of the Coalition, the Data Information Flow project aims to be truly collaborative. If you would like to hear more or become involved then please do contact info@naturalcapitalcoalition.org.

Introduction

The issue

The Natural Capital Coalition has identified data as a priority area for action in consultation with pilot companies and Coalition organizations[3]. Many of the businesses involved in the pilot testing phase of the Natural Capital Protocol[2] identified challenges around securing access to reliable, complete, and credible data. CREM & Arcadis[4] found that the data required for natural capital assessments differed from that normally collected by companies, and that assessments required a range of sources of data that were not readily accessible, particularly contextual data and data on trends.

Failure to access robust data in assessments could result in a focus on 'easier' to measure assets, rather than dealing with the real complexities of natural capital. It could also undermine the value of natural capital assessments as a decision-making tool. Conversely, providing companies with guidance on key natural capital datasets, their limitations, and how to overcome them will enable more rigorous natural capital assessments and better management of risks and opportunities.

[2] https://naturalcapitalcoalition.org/natural-capital-protocol/

The project

Working with businesses, the UN Environment World Conservation Monitoring Centre (UNEP–WCMC), on behalf of the Natural Capital Coalition, is delivering the 'Data Information Flow' project to address this. This report sets out the results of phase 1 of the project. The initial scoping phase of the Data Information Flow project aimed to:

1. **Define the business needs relating to natural capital data** *(see 'Data and the Natural Capital Protocol')*;
2. **Determine the extent to which existing natural capital data meet these needs** *(see 'Data and natural capital assessments')*;
3. **Identify the barriers that limit the use of data for business needs** *(see 'Unlocking data challenges for natural capital assessments')*; **and**
4. **Identify some potential solutions for delivery in a next phase of work** *(see 'Unlocking data challenges for natural capital assessments')*.

Approach

This report is based on: (1) a survey of the Natural Capital Coalition's network on data needs, sources, challenges, and solutions; (2) structured interviews with 10 organizations representing different aspects of the 'natural capital data ecosystem' (defined below); and, (3) a review of existing data standards and guidance. It also draws from consultation sessions and Protocol Application reviews conducted from 2015–2017. See Annex 1 for further detail on the approach used.

In this initial phase of the Data Information Flow project, a comprehensive analysis of existing datasets and platforms was not conducted as it was beyond the scope of the project.

[3] https://naturalcapitalcoalition.org/wp-content/uploads/2018/12/Combining-Forces-Priority-Areas-for-Collaboration_Print-PDF_28pg_Final.pdf

[4] CREM & Arcadis. 2017. Reporting on natural capital. Guidance on a practical Approach. Available at: http://crem.nl/wp-content/uploads/2018/02/Reporting-on-Nat-Cap_A-practical-approach_31-August-2017-1.pdf

Natural capital assessments and data

This section defines natural capital, use of data in the context of the Natural Capital Protocol, outlines the 'natural capital data ecosystem', and the data requirements for robust decision-making.

Take away messages

- There are barriers to the effective use of data to inform decision-making processes throughout all stages of natural capital assessments.
- Four elements influence robust data use: accessibility, infrastructure, quality, and capacity.
- Response options for these four elements create opportunities to ensure data challenges do not become data blockages in natural capital assessment processes and consequential decision-making.

Defining natural capital data

'Natural capital data' describes a wide range of data used within natural capital assessments; these data can relate to the:

- **stocks** of natural capital (plants, animals, air, water, soils, and minerals);
- **flows** of ecosystem services;
- **impacts** and **dependencies** on natural capital; and
- associated **costs and benefits** to business and society.

The Natural Capital Protocol identifies two types of data: primary data (collected internally or from suppliers), and secondary data (derived from peer reviewed publications or grey literature, past estimates, or using modeling techniques).

Data use in natural capital assessments

Data and the Natural Capital Protocol

The data needs of businesses seeking to apply the Natural Capital Protocol are defined by the decisions they are intended to inform. Survey respondents identified the following uses (i.e. the business needs) of natural capital data to be the most common:

- assess risks to, and opportunities/impacts on, stakeholders;
- estimate total/net impact in order to influence strategy and sustainability decisions; and
- communicate with stakeholders.

Data is required when applying all stages of the Natural Capital Protocol. Figure 1 below shows the different uses of data throughout the 'Frame', 'Scope', 'Measure and Value', and 'Apply' stages of the Protocol.

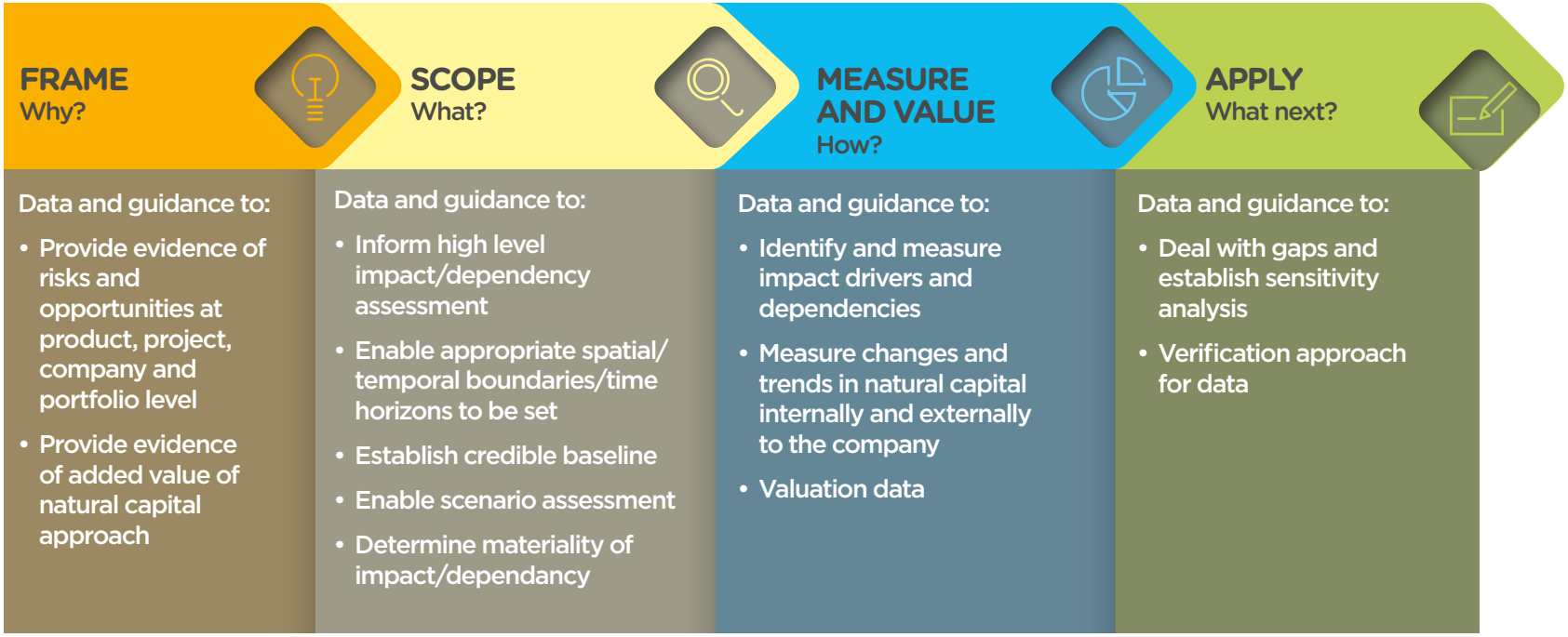


Figure 1
Data needs identified throughout the different stages of the Natural Capital Protocol.

Company feedback indicates that the 'Measure and Value' stage is particularly data intensive, but that challenges are being experienced throughout all stages of the Protocol.

The natural capital data ecosystem

The data ecosystem is complex. Data may be derived from internal or external sources; may be measured or estimated; or may be reliant upon complex calculations and coefficients before being applicable to business decisions. External sources of information may range from NGOs, to energy suppliers, communities, governments, consultancies, or consumers. Figure 2 below shows a simplified version of this ecosystem.

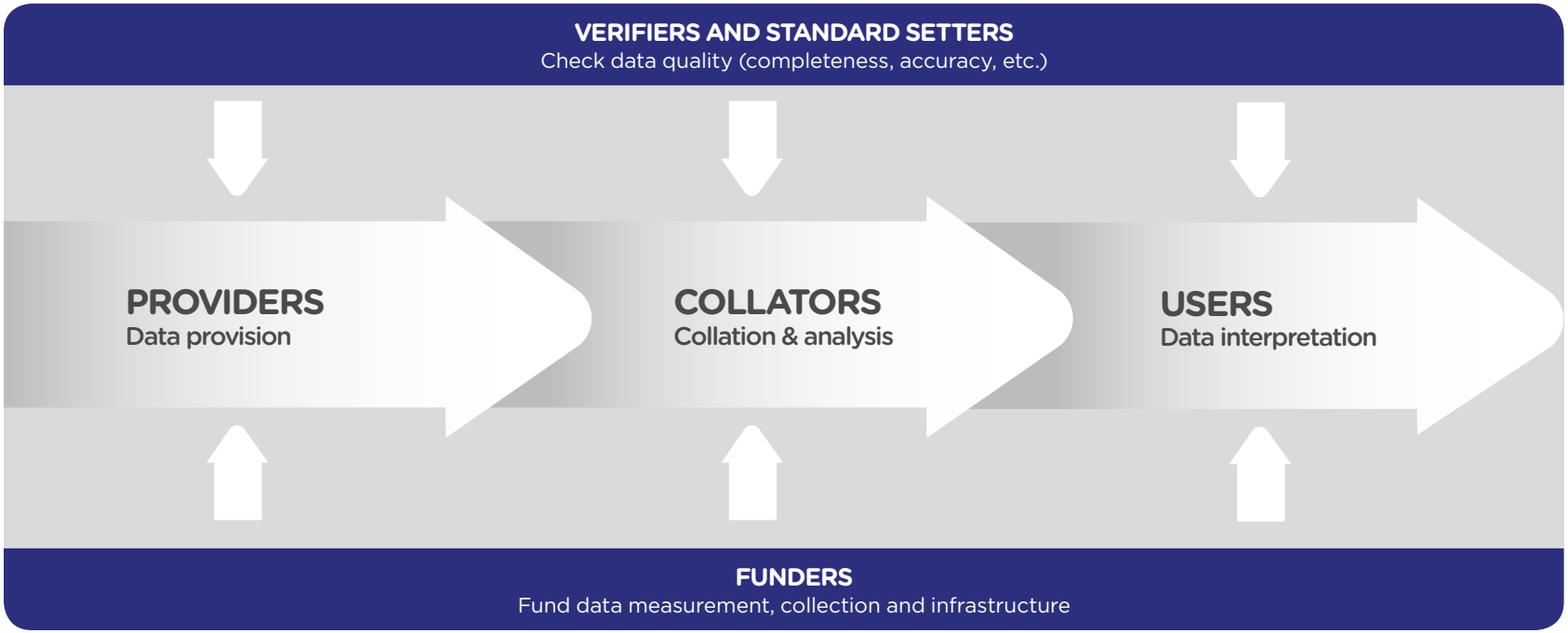


Figure 2
Simplified schematic of the natural capital data ecosystem.

The detail of specific data ecosystems will vary between and within sectors, companies, and issues. Sometimes the data ecosystem will be more complex, with some groups fitting into multiple categories (for example, a "Provider" may also be a "Funder", and "User"), and the flow of data may therefore, not always be linear. Figure 3 gives an example of a data flow for natural capital assessments carried out by BASF. This example indicates the complex nature of the data ecosystem. For full case studies, see Annex 2.

Requirements for robust decision-making

In order to confidently use and call upon data in any capacity or sector, assurance is required in the fact that the data is reliable and trustworthy. Within any data ecosystem **there are four main elements that contribute to reliable and trustworthy data to support robust decision-making: accessibility, infrastructure, quality, and capacity.**

These four elements are interlinked: the ease of accessibility is driven by presence of a strong data infrastructure, which underpins quality and supports robust capacity.

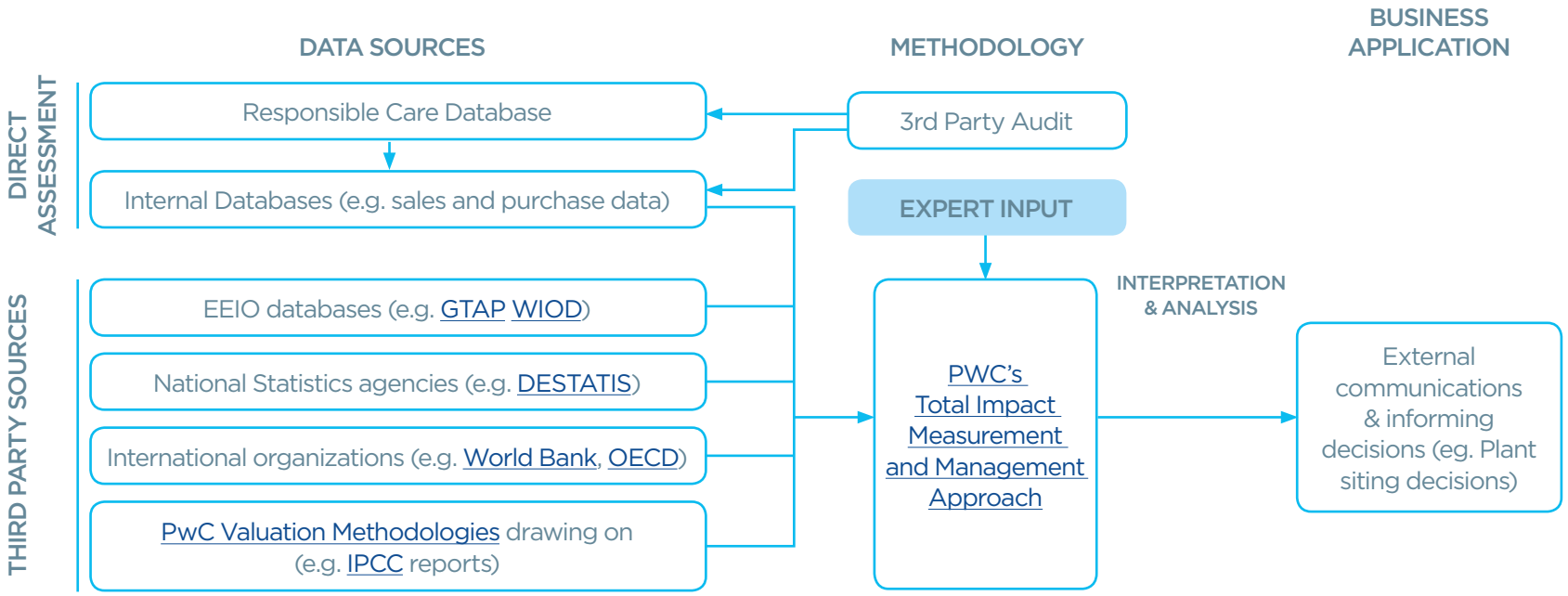


Figure 3
Data sources used by BASF in undertaking a natural capital assessment.

Data use in natural capital assessments – key findings from stakeholder survey and desk research

This section outlines the results of a survey of organizations within of the Natural Capital Coalition's network with an interest in data, focusing on their data use, challenges, and suggestions for potential solutions. It also summarizes the results of desk-based research into existing guidance relevant to the use of natural capital data in assessments.

Take away messages

- A wide range of data types and sources are being used by companies to cover a broad range of environmental issues.
- Data needs and challenges will vary according to the nature of company operations and decision-making contexts.
- Guidance is being used to support access to, and use of, data. There is no single 'go to' guidance to support data use in natural capital assessments.
- Assurance over data quality is limited, although those issues that are governed by well-developed regulations have higher levels of assurance.

Data and natural capital assessments

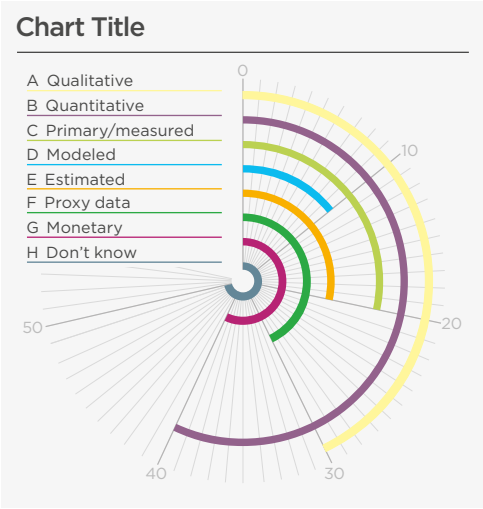
There are a complex array of data types and sources being used to inform corporate natural capital decision-making. Data used spans a number of issues, but also a range of data types (measured, modeled, proxy, qualitative, quantitative, estimated, and monetary). Other key findings include:

- **Data for some issues are more frequently used than for others:** biodiversity[5], water use, freshwater ecosystem use, greenhouse gas (GHG) emissions, and terrestrial ecosystem use (see Figure 4) were the data categories identified as most frequently used.
- **Quantitative data is widely used:** quantitative data, whilst representing a relatively small proportion of the total data used, was found to be the most commonly used data type in natural capital assessments. Further, 'primary/measured data', 'qualitative', and 'modeled' ranked highly across the data categories being used also (see Figure 5).
- **Monetary data is not well used:** survey respondents infrequently use monetary data within natural capital assessments. This could reflect a lack of use of valuation in assessments or a use of qualitative measures to inform valuation decisions.
- **Assessment of some natural capital types is disproportionately reliant on the use of qualitative data:** users of 'biodiversity' and 'marine ecosystem use' data categories had a disproportionately high use of qualitative data. This may suggest that for these data categories, quantitative data is not of sufficient quality or quantity to inform assessments. Data on marine ecosystem use in particular showed lower results for 'primary/measured data' reflecting the challenges of collecting data within the marine environment.

[5] This finding departs from the finding of other associated natural capital studies whereby biodiversity data is typically cited as being an area of data paucity.

In order for natural capital data to effectively meet the needs of businesses, it must satisfy a number of key criteria; based on the survey and interviews with key stakeholders, data must be:

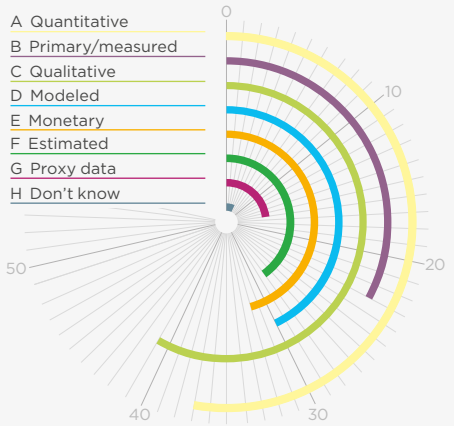
- available in accessible formats;
- licensed suitably for commercial use (e.g. open access in the public domain or with Creative Commons licenses);
- available without prohibitive associated costs;
- available over appropriate periods to support decision-making needs and to demonstrate trends over time;
- at the appropriate and relevant spatial scale (e.g. site/local/regional are preferable to global datasets);
- sourced from credible providers;
- quality-assured and backed up by credible standards and/or methodologies; and,
- be transparent in its limitations.



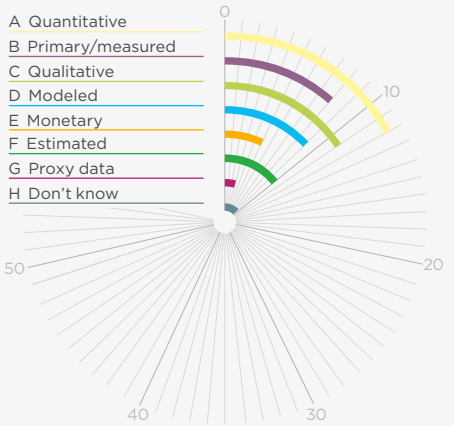
How to read

The outer polar axis represents the total number of survey respondents, each segment is valued at 1.

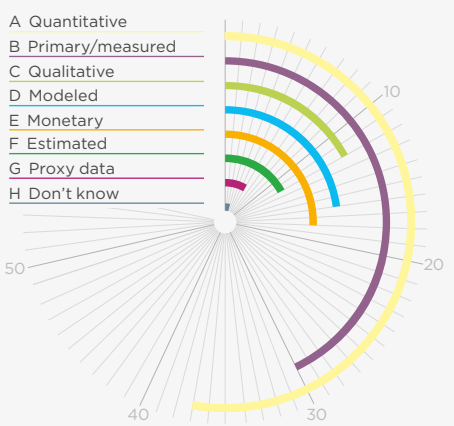
Biodiversity



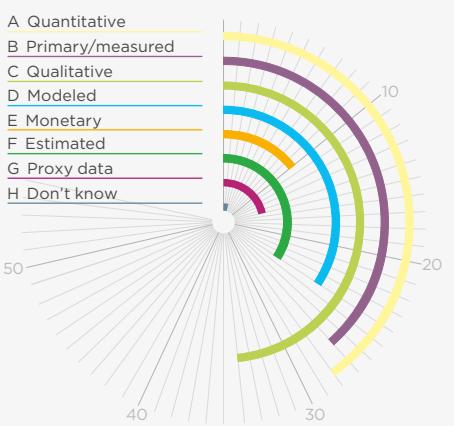
Disturbances



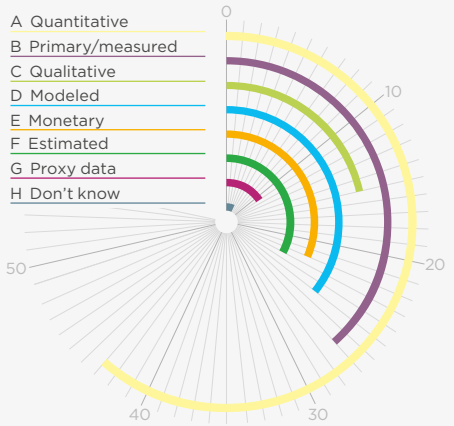
Energy consumption



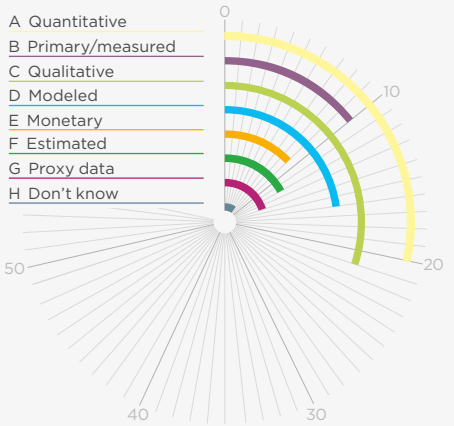
Freshwater ecosystem use



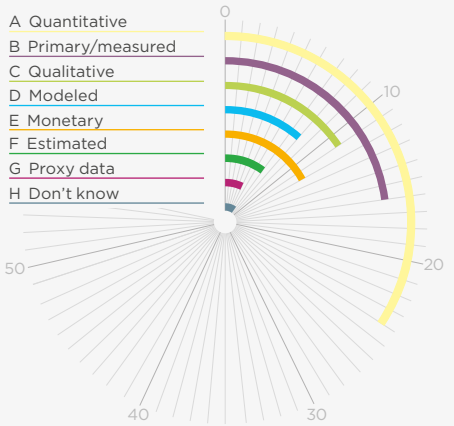
GHG emissions



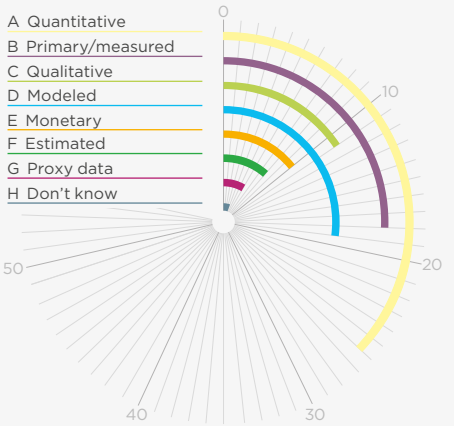
Marine ecosystem use



Materials consumption



Non-GHG air pollutants



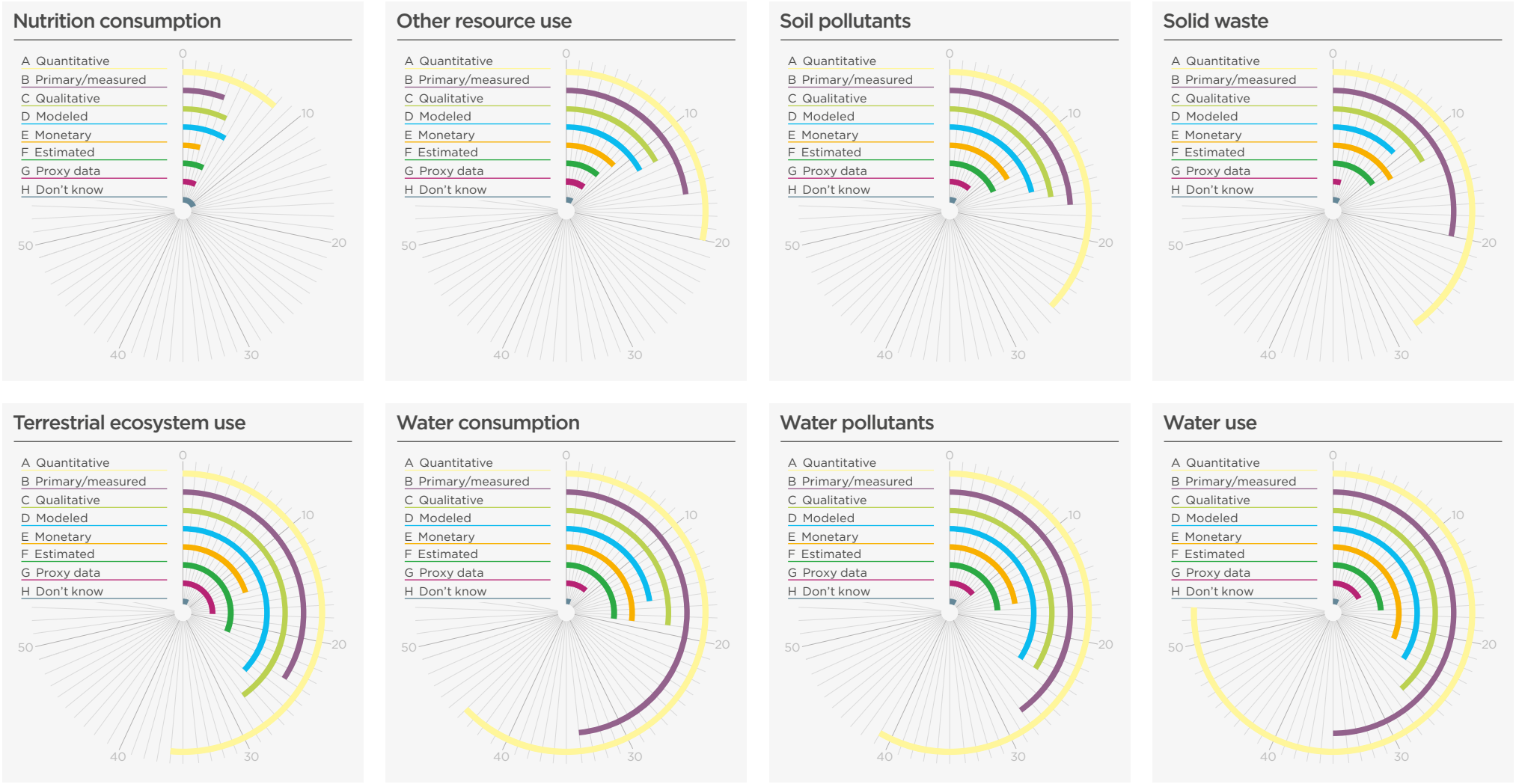


Figure 4
Number of selections of data uses. Colored radial projections represent number of selections per natural capital data category.

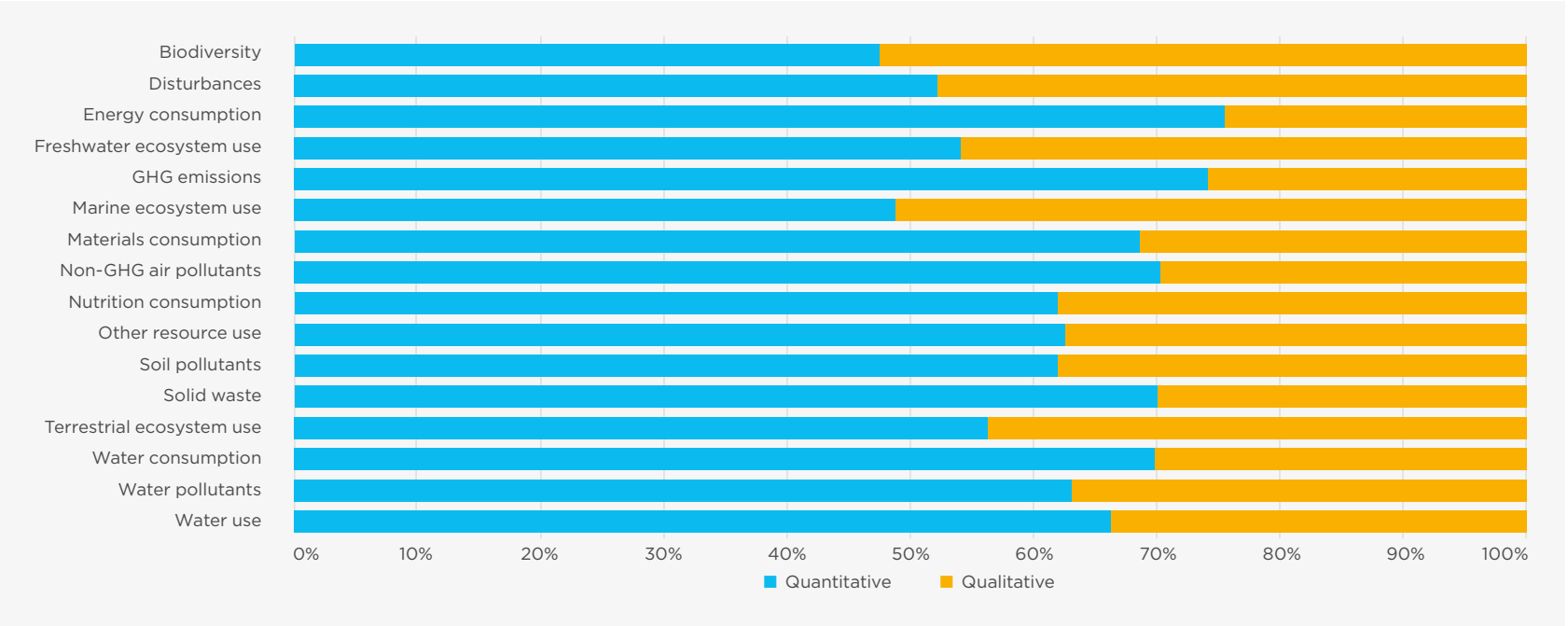


Figure 5
Use of quantitative versus qualitative data in natural capital assessments per natural capital data category.

Data sources

Many different data sources are accessed to generate a corporate natural capital assessment (Figure 6). The specific data source used will vary according to the issue being examined. 'Energy consumption' and 'water data', for example, are more frequently sourced from suppliers rather than inter-governmental sources.

The most important sources of natural capital data included: research institutes and non-governmental organizations, data generated through internal measurements, and local authorities/governments.

Data that is readily available is not necessarily the data that is most needed. Global data was considered to be of least importance, but was the most accessible information. More granular data, such as at the site and sub-national levels, were considered most relevant, but a significant data gap.

Many relevant datasets are likely to be already available through established business information management systems but this poses additional challenges. For example, data is routinely generated and collected for environmental health and safety or regulatory affairs purposes. However, challenges to the use of this data may exist, including the fact that supply chains are not always transparent – and therefore information relating to natural resource procurement and the associated impacts and dependencies will not be visible. Additionally, some information is commercially sensitive, preventing its disclosure and use in assessment processes.

Figure 6
Identification of data sources most frequently used by organizations.

Data quality

Quality of data is key in determining how effective it is for decision-making. Accessing data from a large number of sources, in a variety of formats, gives rise to the potential for significant errors. Having strong data assurance mechanisms, from the point of data generation, to data collation and interpretation, is therefore very important.

Assurance over the quality of the data being accessed is variable and depends on the issue concerned. For greenhouse gas emissions and solid waste data for example, third party assurance is more common. Data validation or assurance processes are most commonly implemented via internal company-led assurance or are validated for quality at source. 'Third party assurance' was the least frequently selected mechanism.

Data guidance

Guidance is another driver of data quality and accessibility, and is a requirement of effective data infrastructures. The survey results show a wide range of guidance is being used already by stakeholders (e.g. business) to inform their use of data in natural capital assessments. Table 1 below shows the five sources of guidance most frequently mentioned.

Consultants were also identified by a number of respondents as a key source of guidance.

A significant amount of guidance is already available on data; however, this guidance is not collated in a single place. The survey results combined with interviews and desk research identified:

- 54 different sources of guidance dealing with two main areas: guidance on data standards, management and quality; and guidance on data directly relevant to natural capital assessments – many of these are not currently in the Protocol Toolkit[6].
- guidance existing in many different locations, for different topics, and of varying accessibility in terms of technical content/readability.
- limited guidance on dealing with differences in data quality and scale, and dealing with data with limited availability. There are also few relevant resources on dealing with complex or "big" data.

Table 1: Respondent selection of data-related guidance used in natural capital assessments.

Guidance resource	Description
Natural Capital Protocol, including the Natural Capital Toolkit	Guidance for businesses undertaking natural capital assessments, including dealing with uncertainty. The Toolkit provides access to a range of tools for guidance and data surrounding natural capital assessments.
Government data standards	e.g. Practical Methods for Data Analysis, US Environmental Protection Agency Guidance on determining whether environmental data is suitable for a given purpose. It addresses issues over uncertainty in data and selecting appropriate statistical methods for datasets.
'Issue based protocols' (for example, greenhouse gas protocols)	Guidance documents specific to impact areas. Providing information on data requirements and methodologies, e.g. PWC's "Valuing Corporate Impacts" which includes guidance for 6 impact areas.
ISO (International Organization for Standardization) Standards	Provide guidance on data standards applicable to a wide range of sectors, many of which are relevant to environmental data.
INSPIRE (Infrastructure for Spatial Information in Europe) data standards	An infrastructure for environmental spatial data developed for use in the European Union. Pre-defined standards for data management aiming to enhance interoperability and optimize data management processes.

Box 1 below, highlights some additional sources of guidance that were identified through interview and desk-based research. These are illustrative only; no assessment of robustness of each approach was made.

Box 1: Examples of available data guidance resources

Sourcing data in natural capital assessments

- Valuing corporate environmental impacts: PwC methodology document, 2015: Addresses six key impact areas: air pollution, greenhouse gases, land use, solid waste, water consumption, and water pollution. It sets out methodology that leads to monetary valuation, including sections on data requirements and a sensitivity analysis. The focus is on data that is readily available within a corporate data ecosystem. Potential data sources are highlighted.
- The System of Environmental-Economic Accounting (SEEA) – United Nations Statistics Division: A framework that includes internationally agreed standards and accounting rules for producing statistics on the environment and its relationship with the economy. This includes guidance on integrating economic, environmental and social data to support decision-making.

Dealing with uncertainty

- Guidance for uncertainty assessment and communication, 2013: The Netherlands Environmental Assessment Agency's guidance on how to identify, assess, and communicate the level of uncertainty associated with a study. This sets out checklists, questionnaires and an 'Uncertainty Matrix' that allows users to identify and rate the importance of uncertainties that lie within their projects. It also addresses effective communication of uncertainty information.
- Monte Carlo Simulation: This helps provide an organization with an understanding of uncertainty in predictive models. It deals with the variation possible with estimated data based on historical data or expert opinions, to produce a range of values that may occur based on the level of uncertainty in the data.

Annex 3 summarizes the guidance reviewed under this project. This aims to make it more accessible to those seeking guidance on addressing various data issues in natural capital assessments, including some of the barriers outlined in this report.

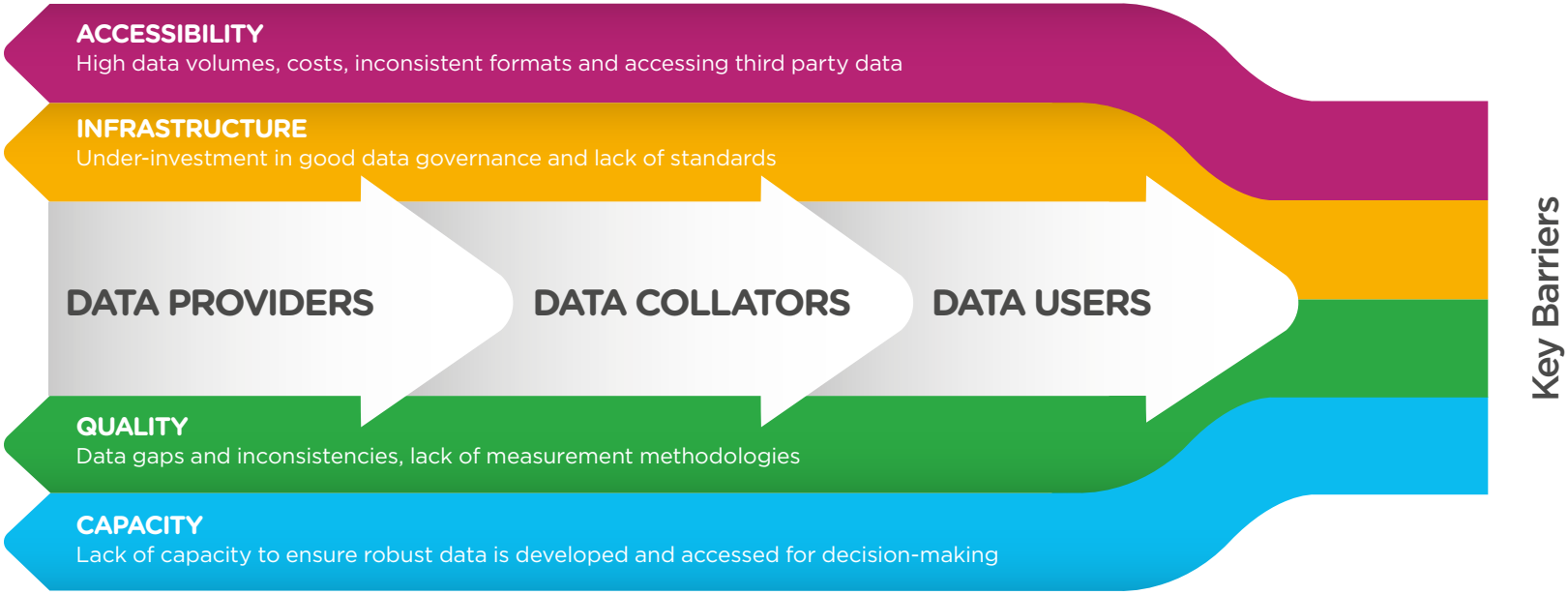
Unlocking data challenges for natural capital assessments

This section sets out the barriers to the flow of data from source to end user for use and application of natural capital assessments, and a range of solutions that could facilitate more efficient flows of information.

Take away messages

- There are inherent challenges associated with the cost, format, volume, complexity, and nature of data required for natural capital assessments.
- Weak governance through poor or inconsistent data management, a lack of systems or strategies, and a lack of policies or standards may negatively impact natural capital data quality and use.
- Data gaps, either in terms of relevant and applicable spatial and temporal scales, subject matter, or within datasets, can result in incomplete or inaccurate assessments.
- There are some quick wins to address these challenges that companies can employ immediately, including the collation and synthesis of existing data guidance and the production of a data directory, as identified by this project.

Figure 7 (below) presents the key barriers and potential solutions as identified through the desk study, stakeholder survey, and structured interviews conducted as part of this project.



Potential Solutions

	ACCESSIBILITY	INFRASTRUCTURE	QUALITY	CAPACITY
Process	• Plan for delays and costs relating to data access • Investigate pathways to robust open access data	• Use of new technologies/ software, and bespoke and automated systems • Investment in data governance (institutions, technologies, personnel)	• Use of internal and external assurance • Modeling and proxies • Use of established methods to determine impact of uncertainty • Invest in filling key data gaps	• Engagement of finance/audit professionals in assessments • Capacity building and training throughout the data ecosystem • Members of the data ecosystem linked to enable better understanding and response to needs • Integrate data considerations into all Natural Capital Coalition projects
Guidance	• Searchable data directory of key datasets • Reference lists of key data sources • Guidance on gap filling using technology	• Data lexicon/ontology with standard terms and definitions • Guidance on key data issues – addressing gaps, ethics, licensing, good data management practice	• Guidance on data quality and verification • Data measurement methodologies	• Case studies on data gathering, analysis and interpretation • Checklist of data characteristics for data filtering

Figure 7
The key barriers and potential solutions identified through the Data Information Flow project.

These barriers and solutions are discussed in more detail below. The potential solutions set out under each element fall into two categories:

- quick wins that companies could take forward immediately;
- longer term actions, including how data considerations can be strengthened within natural capital projects more broadly.

Accessibility

Barriers: High data volumes, costs, inconsistent formats and accessing third party data

Data accessibility encompasses barriers (or enablers) associated with the cost, formatting and licensing of data, as well as the ability of users to find and use data. Data access challenges are placed in two categories:

The extent to which data is readily available in formats that can be used is key to its uptake and use. Data behind paywalls or locked up in document formats that cannot be readily accessed pose challenges for users. Accessibility also considers whether the procedures, mechanisms, agreements and structures are in place to support trouble-free user navigation.

The volume and complexity of data (available and required) can increase the scale of the tasks when undertaking assessments. Large datasets, and large numbers of datasets for different aspects can increase the time, cost and expertise required to conduct natural capital assessments.

Data availability

Challenge	Implications	Example response
Data may be inaccessible due to its format, cost, licensing requirements or ownership by third parties	Assessments may be delayed due to time/costs of accessing data	Factor in costs and time required to access key datasets

Data exists that is not widely available to decision makers; for example, raw data underpinning environmental impact assessment reports may not be published in an accessible, machine readable format. Gaining access to data in a timely and low cost manner was identified by survey respondents and interviewees as a significant challenge. Key accessibility issues identified include:

- **Inability to share data:** for some datasets, issues of confidentiality, or even national security, might hamper the ability to access them. Securing data from partners or third parties may also be challenging and time consuming. More than half of those surveyed consider insufficient flows of data from stakeholders as a barrier.
- **Disincentives for data sharing:** lack of incentives to share natural capital data (e.g. between companies) may arise as a result of competitive advantage.
- **Costs or licensing restrictions:** some datasets require a fee to be paid, or are licensed in ways that prevent use and uptake (e.g. non-commercial licensing which strictly prohibits commercial use, sometimes regardless of payment), making them costly and time consuming to access. Costs of data handling were cited by more than half of survey respondents as a potential barrier.
- **Incompatibility of datasets:** challenges arise when different data sources are only available in formats that are incompatible, or in formats that take a long time to make compatible.
- **'Dark' data:** some data may not get digitized, uploaded, or shared. Data also exists in formats (e.g. PDF reports) that are not readily accessible – ideally, data should be machine readable to be widely used. For many datasets, survey respondents indicated that metadata was not always available.
- **Ability to demonstrate trends:** datasets that are updated periodically that meet with the temporal scales of interest and relevance for businesses and their decision-making processes.

In the absence of a ready solution, data stakeholders, such as companies, are beginning to plan natural capital assessments that are mindful of the time and costs associated with accessing data. A longer term solution to some of these issues could be to use technological advances to unlock data (see Box 2).

Box 2: Technological solutions to data access constraints experienced by companies conducting natural capital assessments

The development of powerful cloud-computing platforms and the movement towards open access datasets have enabled rapid advances in environmental monitoring. These progressions will revolutionize environmental data collection in terms of the ease of collection, frequency of updates, and completeness of datasets.

Data openness: National governments are increasingly moving away from holding data for sale and moving towards complete open data models. For developed nations, such as the UK, this offers companies access to an unprecedented source of high resolution data (as illustrated by DEFRAs recent open data strategy[7]) which can form an integral part of a natural capital assessment.

Data availability: Recent technological advances in remote sensing can aid in data collection. For example, the European Space Agency's Sentinel program now provides imagery on a weekly basis for much of the world's landmass. This has a spectral resolution of 20–30m which could be used for monitoring and evaluating many natural capital assets and their proxies.

Data compatibility: In the past decade, the number of file formats has risen by more than 1000%. With this increasing number of formats, it is not always possible for in-house software to read them all, hence investment in new software/computing capacity may be required. The rise of publically available super-computing, such as Google Earth Engine presents one solution towards resolving these challenges, with many time-consuming data transformations now being conducted in a fraction of the time.

[7] https://data.gov.uk/sites/default/files/Defra%20Open%20Data%20Strategy.pdf

Data volume and complexity

The volume of data that companies have to sift through to undertake natural capital assessments is a major challenge (See Box 3 example). This can act as a barrier to carrying out such assessments as a result of:

- **large investment of time and resources** required to deal with the quantities of data;
- **uncertainty** about the level of detail required to make a robust assessment; and
- **complexity of data to support detailed analyses** (such as full monetary evaluations) can add to the time required to identify and acquire data.

This is particularly true for assessments conducted across multi-tiered supply chains. See Case Study 1 (Annex 2).

Box 3: Jaguar Land Rover – iterative approach to dealing with high data volume

Jaguar Land Rover had to call upon 1.3 million[1] pieces of data to produce their natural capital valuation. In order to break down the data volume and complexity barriers, Jaguar Land Rover found that, in the absence of a comprehensive starting dataset, it was useful to run a limited-scope pilot assessment looking at a single product, site, or service, for example. By building upon this approach over several iterations, more and more input data can be incorporated, and the output data will become robust enough to inform decision-making processes.

1 (Summary Report reference)
Ellison, I. 2018. Jaguar Land Rover: Natural Capital Assessment – What Next? ENDS Natural Capital Conference, 27th June, London

Potential solutions: accessibility

A number of solutions were identified to accessibility challenges (Table 2). Some are quick wins – solutions that companies were already using as workarounds to challenges. Other solutions are longer term, which can betaken forward collaboratively or integrated into the Natural Capital Coalition's ongoing activities. .

Table 2: Potential solutions to data-related challenges encountered in natural capital assessments.

	Potential solution	Description
Quick wins	**Plan for delays and costs associated with data access**	Incorporate time (resources) and budget into natural capital assessment plans to ensure that the time required to access diverse datasets is considered.
Long-term action	**Data directory**	A searchable data directory of key datasets which meet appropriate criteria in terms of scope, scale, and quality (where data quality is made transparent). (N.B. in such a database, data would be linked to only, not hosted.) An initial step in creating this directory would be to confirm the typology of natural capital data required and to review the extent to which existing data platforms and datasets meet the requirements expressed by data users in this analysis.
	Reference lists	A list of key data sources could be developed for areas where stakeholders identified particular gaps, e.g. biodiversity, water, valuation.
	Technology	Guidance on the use of technology to access currently inaccessible data (e.g. Environmental Impact Assessment data, or data 'hidden' within scientific publications), and where it could be employed to reduce data error.
	Open access and licensing	Investigate how key datasets can be made open access, whilst remaining robust, and determine the incentives or disincentives to increasing data access. Communicate standard licensing requirements to data providers to facilitate access rights (i.e. placing data in the public domain or using Creative Commons licenses).

Survey respondents indicated that a directory of existing datasets would be the most useful potential resource for development under this project. This could take the form of a searchable database of key datasets which meet appropriate criteria in terms of scope, scale, and quality. Prior to developing a new data directory there is a need to recognize and review a number of similar directories or platforms that have been, or are being, developed. Examples include, in the UK, the Centre for Ecology and Hydrology Natural Capital Metrics database[8] and the web based tool 'ENCORE' (Exploring Natural Capital Opportunities, Risk and Exposure) from the Natural Capital Finance Alliance (see Box 4).

Box 4: ENCORE – Exploring Natural Capital Opportunities, Risk, and Exposure

The Natural Capital Finance Alliance, in collaboration with UNEP-WCMC, have developed the web-based ENCORE tool. ENCORE enables users to visualize the exposure of economic sectors to natural capital risks according to their geographical location.

It will enable a better understanding of the risks that environmental degradation causes for businesses by allowing users to explore how different industries are linked to natural capital assets and the drivers of environmental change, such as climate change, that affect them. Users could, for example, use ENCORE to identify sectors in a portfolio with high natural capital risk, or analyze drought and its potential impact on credit risk in agriculture.

Underlying this tool is a comprehensive analysis of available natural capital datasets screened against a range of quality criteria.

[8] https://www.ceh.ac.uk/our-science/projects/natural-capital-metrics

Infrastructure

Barriers: High data volumes, costs, inconsistent formats and accessing third party data

Data infrastructure is described by the Open Data Institute[9] as **"datasets, the technology, training and processes that makes them useable, policies and regulation such as those for data sharing and protection, and the organizations that collect, maintain and use data"**. It encompasses measurement protocols, standards and guidance, and software. Three groups of challenges relate to data infrastructure:

Weak governance, including management, systems, policies and standards, can result in poor data. These factors in isolation or combination have an impact on data quality.

Data volumes may exceed capacity for analysis as a result of the complexity of data required to support a natural capital assessment (as opposed to analysis of individual facets of environmental issues). This can require significant updates to systems, technology and processing.

Lack of standards and guidance on data use directly impacts on quality of data and resulting analyses.

[9] ODI. 2016. Principles for strengthening our data infrastructure. Online: https://theodi.org/article/principles-for-strengthening-our-data-infrastructure/. Accessed 20/11/18.

Weak governance

Challenge

Extent to which data owners have good data governance (setting appropriate standards, ensuring quality etc.)

Implications

Lack of good data governance may result in impaired data quality (e.g. inaccuracies, incomplete datasets, unverifiable data) and accessibility leading to loss of credibility

Example response

Internal data management guidance/focus on high quality data/awareness of limitations of data

Examples of poor governance include:

- inconsistent management of existing data;
- lack of systems or data strategies for collating and managing natural capital datasets;
- lack of policies to ensure ethical accessing and use of data;
- lack of standards or certification for quality assurance and reliability.

There is a need, therefore, to invest in the key datasets required for natural capital assessments, to ensure they are available and fit-for-purpose for decision-making. Although some data production and analysis is well-funded, other data is expensive to collate and maintain, but is not considered a public good. Three key global biodiversity datasets for example, cost in the region of USD6.5 million to maintain annually, yet are underfunded and reliant on significant inputs from volunteers[10]. It can be difficult to secure funding at the level required for good data governance.

"In order to deliver robust data for natural capital assessments, it is vital that there are properly funded and supported organizations in place that view it as their responsibility to produce and maintain data."

Jeni Tennison, CEO, Open Data Institute

[10] Juffe-Bignoli, D., Brooks, T.M., Butchart, S.H.M., Jenkins, R.B., Boe, K., Hoffmann, M., et al. 2016. Assessing the Cost of Global Biodiversity and Conservation Knowledge. PLoS ONE 11(8): e0160640. https://doi.org/10.1371/journal.pone.0160640

Data volumes exceed capacity of technology

Challenge	Implications	Example response
Data volume required to understand impact drivers, impacts, and dependencies in natural capital assessments is significant and may be beyond the handling capacity of existing data management systems	New systems may be required to handle data volumes leading to increased cost of assessment (time and resources)	Understand limitations of existing data systems; use third parties with bespoke systems to assist; increase data automation (e.g. collection); adopt new technology

Continual data growth requires that the systems, approaches, and technology grow with them to ensure efficient data handling, management, and processing.

Globally, the amount of data and information generated and collected grows year-over-year. The volume of this data alone presents significant challenges in its management and use (including all stages from storage, to interpretation, to analysis).

Coupled with this continual growth in data volume is the expansion in different types of data (e.g. tabular data, hierarchical data, documents, e-mail, metering data, financial etc.), and the increasing velocity at which data is being produced and collected.

Lack of standards and guidance

Challenge	Implications	Example response
Data guidance and standards are lacking or dispersed in multiple sources	Paucity of guidance may increase assessment costs (i.e. time invested in searches) and affect assessment quality	Companies may set internal standards or guidance or use quality measures (e.g. Pedigree Matrix or Monte Carlo simulation)

More guidance on data use in natural capital assessments is required (Table 6, Annex 1); specifically in the following areas:

- **data process:** how to deal with data-sourcing ethics and equity, licensing issues and data negotiations, avoiding delays and additional costs associated with accessing data, and addressing data limitations within decision-making;
- **identifying consistent methodologies** for data collection, including the use of technology to streamline effort and reduce error, the development of methodologies where none exist, and addressing issues such as baseline setting;
- **sources of data** including how to find existing data to reduce duplicate efforts of data gathering;
- **addressing data gaps** including how these gaps can be filled and addressing the uncertainty data gaps introduce into decision-making; and
- **data quality** specifically relating to biodiversity and water use, but on data assurance for all issues.

Potential solutions: infrastructure

Table 3 sets out potential solutions to deliver effective natural capital data infrastructure. The nature of infrastructure is such that few quick wins are possible. Stakeholders consulted in this project requested guidance on natural capital data that draws on the key elements that are currently dispersed in many locations. Specifically, the production of web-based guidance to address key gaps in knowledge was highlighted as a priority solution. Part of this guidance could include the directory of existing datasets identified previously.

A directory of data providers, an analysis of data quality, and guidance on key data challenges were also identified as potentially useful resources. Such guidance could be stand-alone or integrated into other suitable resources – for instance, Natural Capital Protocol Sector Guides and Technical Supplements.

Table 3: Potential solutions to data-related challenges encountered in natural capital assessments.

	Potential solution	Description
Long-term action	**Use of new technologies/software**	Use of bespoke software systems, increased automation of data processes, and the use of new technologies that identify and process data.
	Data lexicon/ontology	Bring together key data providers and users to agree a standard set of data definitions and terms to ensure consistency of understanding across the data ecosystem (e.g. developers, collators, and users).
	Guidance on key data issues	The production of web-based guidance on data use in natural capital assessments.
	Investment in data governance	Provision of support to key data providers to ensure good data governance is implemented and sustainable, robust data infrastructure is in place. This could include facilitation of investment in technology, training, and supporting policies and regulations to ensure a consistent, comparable, and high quality approach to securing and managing data to enable more robust natural capital assessments.

Although datasets used by companies will differ to some extent from those used by governments in natural capital assessments, there is some common ground, particularly in relation to standards, guidance, and measurement protocols. The activities above must, therefore, be undertaken with the full involvement of all elements of the natural capital data ecosystem, from providers, to collators and users, funders, standard setters, and governments.

This will cut across business, governments, and civil society.

Quality

Barriers: Data gaps and inconsistencies, lack of measurement methodologies

The quality of data is essential in establishing its reliability for use and supporting decision-making processes. Data quality can be assessed in terms of its completeness and accuracy, i.e. the extent to which there are gaps in the data available, its availability at applicable scales (e.g. temporal or spatial) and resolution, and its consistency.[11] Two key areas of quality were identified as challenging:

Data gaps, either in terms of relevant and applicable spatial and temporal scales, subject matter, or within datasets, result in incomplete assessments. This can introduce uncertainty to the outputs of assessments, which undermines their uptake and utility.

Robustness and credibility of data is crucial in any emerging field, with natural capital assessments it is no exception. In order to produce robust assessments that withstand scrutiny, the data used must be credible and come from authoritative sources.

[11] https://www.ibm.com/analytics/data-quality

Quality

Data gaps

Challenge	Implications	Example response
Data gaps can render assessments incomplete	Time required to identify and access useful data is increased	Use of methods to establish range of outcomes based on level of data available and assess impact of uncertainty

The greatest barrier faced by organizations relating to natural capital data is a lack of high quality data[12,13]. In particular, data is often not available at the extent, scale, or frequency to support decision-making processes.

"Data within national level accounts are not accessible to use on project-level assessments, but there is nothing else out there."

Julia Baker, Biodiversity Technical Specialist, Balfour Beatty Construction Services UK

[12] https://naturalcapitalcoalition.org/natural-capital-protocol-case-study-for-akzonobel/

[13] WBCSD. Unpublished. Summary of challenges faced by six companies applying the 'Frame' and 'Scope' stages of the Natural Capital Protocol.

The most substantial gaps in data quality have been identified as the **lack of temporal data at relevant scales** and the **lack of spatial data at the site level** (see Figure 8 below).

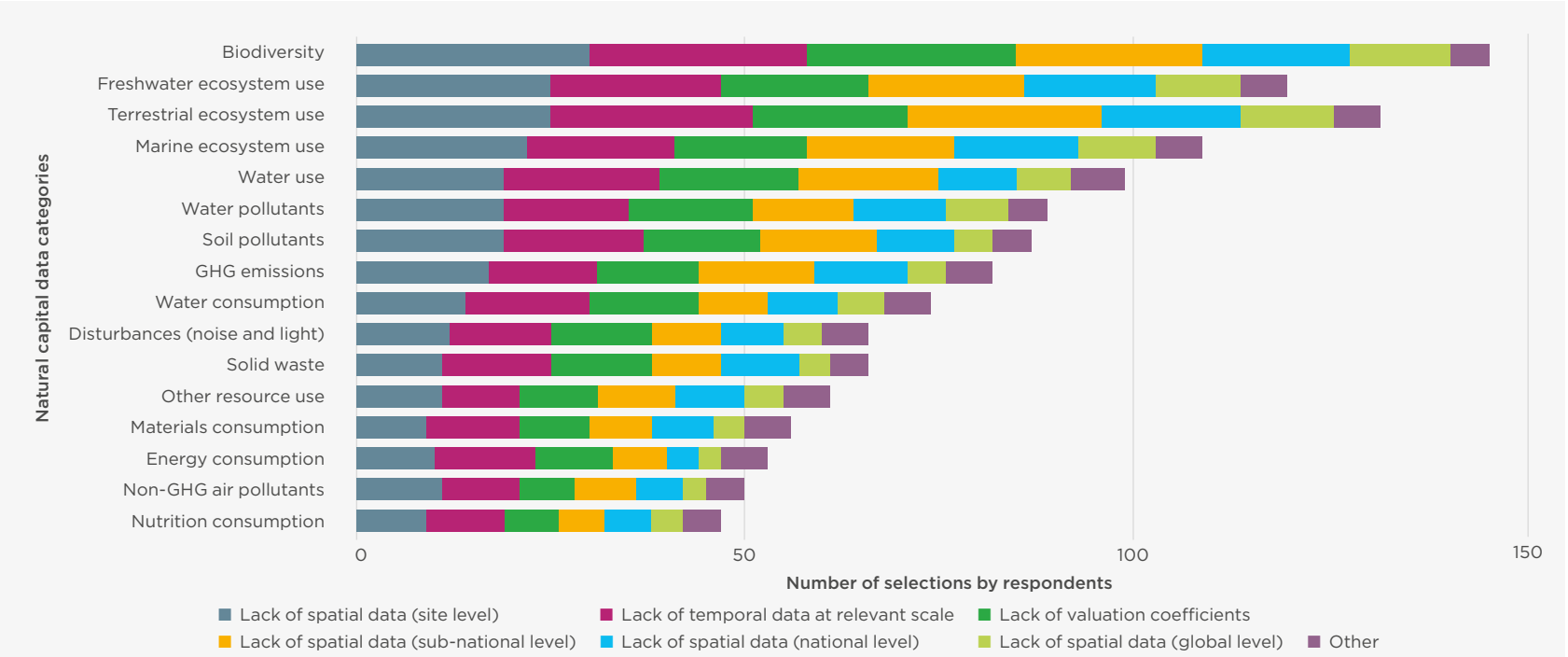


Figure 8
Survey respondent selections of the data gaps most commonly associated with natural capital assessments. Horizontal bars indicate the total number of respondents who selected each natural capital data category. Colored segments within bars indicate the number of selections for individual data gaps across data categories.

Key data gaps identified through the survey, interviews, and a literature review include data on:

- **Dependencies:** ecosystem service data including hydrological data (including stream gage), water scarcity flow requirements, topography, land use land cover, fisheries, fish stocks, raw material more broadly, private crop and water use, and population data. Data on minimum function and flow requirements is lacking.
- **Valuation:** data that gives insights into the links between environmental and financial impact and valuation coefficients, cost/estimated cost of changes in practice. One interviewee noted that valuation data was available on a national level and was of limited use at a local level.
- **Biodiversity:** most frequently cited data gaps within the survey conducted were biodiversity, terrestrial ecosystem use, freshwater ecosystem use, and marine ecosystem use.
- **Opportunities:** data on opportunities to enable delivery of a positive contribution – the current focus is on negative impacts.
- **Pressures and drivers of change** to impact; and
- **Corporate-wide data:** data across global operations and value chains.

Data gaps can result in extrapolation, estimation, and use of external frameworks to provide proxies. This can introduce inaccuracy and uncertainty into the assessments. A number of companies have addressed this by limiting the results of the assessment's influence in decision-making, i.e. using it as just one piece of the information that ultimately fed into the decision made. Others were using guidance resources on dealing with uncertainty in assessments.

Box 5: Addressing data gaps in natural capital assessments

- **FMO:** The Dutch development bank (FMO) makes use of multiple data sources. Primary data is preferred and can be supplemented by consultancy reports. As early screening FMO deploys IBAT. During due diligence, assumptions are checked and Environmental and Social Action Plans developed with clients. FMO can also draw on its Impact Model (input-output model) to derive estimates for GHG emissions.

Robustness and credibility

Challenge	Implications	Example response
Data is from a wide variety of sources with varying levels of influence possible (i.e. data from third parties), automation and granularity	Data more readily accessible and of higher quality for some assets and issues than others	SAP's internal GHG reporting system records the level of data quality via a ranking system

The extent to which data quality is a challenge depends on the proposed use of the data and the nature of the decision maker using it. For some purposes low quality data will suffice; however, where a robust and credible output is required, the input data must also be robust.

Key quality requirements include: standards for data quality; clear definition of dataset limitations; transparency regarding the methods, calculations and valuation coefficients used; clear identification of the spatial resolution of datasets; and, datasets that are complete and accurate.

Factors that influence data quality:

- **The level of manual intervention** in a data system was considered to be a particular risk to data quality given the risk of human error. Automation of data systems can reduce this and introduce efficiencies into the data system.
- **Level of influence over the data originator** was a key factor in: a) the ability to access data; and, b) in controlling its quality. Owned assets are easier to secure data from than leased; managed operations are easier than joint ventures; and, directly owned operations are easier than securing data from suppliers.

Controls employed by companies to address data quality risks include internal and third party assurance on key datasets, increasing automation, recognition of data limitations within the methodology employed, and expectation management over the role natural capital assessment can play in decision-making in the face of data gaps.

"For communications and reporting purposes, the data available are sufficient. When talking about decision-making or steering a company beyond it's own operations, so taking a value chain perspective into account, the data quality, robustness and granularity needs to be improved."

Christian Heller, Senior Consultant Sustainability Strategy, BASF

Potential solutions: Quality

Several of the companies interviewed are working closely with internal finance functions to build capacity to deliver high quality natural capital data for assessments – this is considered a quick win. Similarly, accessing existing guidance on modeling, proxies, and the implications of uncertainty in decision-making is possible right now.

The guidance outlined in the infrastructure section above could also address quality issues.

Filling data gaps is more challenging and will require considerable time and resources. Development of a data directory, as per Table 2 above, would enable identification of actual (as opposed to perceived) data gaps. It may be possible to fill some of these data gaps through the use of new technologies – such as those discussed in Box 2. For example, near real-time data is increasingly available through Earth Observation (EO) technology allowing collection and presentation of data on land use, land use change, ecosystem extent, flood inundation, and many other environmental features and processes.

The Natural Capital Finance Alliance, as a part of the Advancing Environmental Risk Management project, examined datasets available at a global level that could inform assessments of risk and opportunity linked to natural capital assets and the drivers of change potentially impacting on them. This could act as a starting point for identifying and addressing data gaps.

Table 4: Potential solutions to data-related challenges encountered in natural capital assessments.

	Potential solution	Description
Quick wins	**Use of internal and external assurance**	Use internal and external resources (e.g. cross-departmental collaboration, consultants etc.) to provide assurance over data used within natural capital assessments where data quality is not assured at source.
	Modeling and proxies	Companies should draw on the guidance already available (see Annex 3) and use of modeling approaches to provide data estimates where measured data is not available.
	Use of established methods to determine impact of uncertainty	Use of statistical/analytical methods to look at a range of outcomes using the same data (e.g. Monte Carlo simulation/Pedigree Matrix). The use of such methods could be outlined in guidance on data issues.
Long-term action	**Guidance on data quality and verification**	Guidance should be produced to enable companies to deal with quality issues, including guidance on verification, how to use models/ proxies to fill data gaps, and guidance on how to deal with uncertainty in decision-making.
	Invest in filling key data gaps	Secure investment in dataset development for impacts and dependencies where data is particularly poor, and explore the use of technology to fill gaps.
	Data measurement methodologies	Development of measurement methodologies for issues such as biodiversity, which do not currently exist. These can be internal to the organization undertaking the assessment or, preferably, made transparent.

Filling data gaps will require long-term, broad-scale commitment to data collection, monitoring, and data infrastructure from governments, companies, and civil society – especially in those areas considered to be critical for effective natural capital assessments. Given that data issues are common to government and private sector natural capital assessments, an assessment of data gaps, agreement on gaps to prioritize, and investments to fill those gaps should be done collaboratively for both sectors.

Capacity

Barrier: Lack of capacity to ensure robust data is developed and accessed for decision-making

The ability of stakeholders throughout the data ecosystem to collect, clean, organize, publish and use data is central to its uptake and effectiveness to support natural capital assessments and decision-making processes.

Lack of capacity

Challenge	Implications	Example response
Lack of capacity among data gatherers, collators, interpreters and users to understand data and data issues	Lack of understanding of data and data issues may lead to misinformed decision-making	Use of finance team's knowledge of data systems, integrity and quality testing to build capacity

Capacity is considered, not only in terms of technical capacity to understand and carry out assessments, but also in terms of human and financial resources to commit to the process of data collection and analysis. The latter can be intensive, particularly given that the disparate nature of the required data can exacerbate this. One interviewee identified capacity challenges throughout the data ecosystem, from surveyors in the field, to funders, to data collators and users.

A number of areas where capacity is lacking have been identified:

- **Lack of capacity to identify and resolve data issues.** Environmental or sustainability teams do not always possess the relevant data capacity to call upon for decision-making purposes, whereas finance teams have an inherent understanding of data integrity. Some companies have adopted strategies to work very closely with their finance teams while undertaking their assessments. This enables them to build on the strength of knowledge and experience on data integrity issues held by accounting teams.
- **Lack of capacity to address uncertainty or gaps in datasets.** Experience is required in identifying which data carry the most assumptions, and those that are responsible for most variability in the outcomes of assessments. Without this it is difficult to identify/select which data is reliable.
- **Lack of ability to use emerging data technologies to streamline effort.** Our increasing ability to synthesize and communicate patterns in data in ways that are useful for decision makers has yet to be fully explored in the context of environmental, and specifically natural capital, data. There are also opportunities to adapt and adopt advancements in the use of big data from the commercial sector for example, integrating them with environmental datasets to generate new insights. Big data could bring about transformative change, unlocking new analytical approaches and insights for natural capital assessments.[14]
- **Lack of capacity to understand the implications of data limitations in decision-making.** Lack of experience and understanding to know what to do with the data once collated, to inform effective decision-making was identified by interviewees as a potential challenge. It is important to manage expectations regarding the use of natural capital assessments to inform decision-making based on the limitations resulting from access to poor quality or incomplete data (see Box 6).

[14] Keeso, A. 2014. Big Data and Environmental Sustainability: A Conversation Starter. Smith School Working Paper Series. Working paper 14-04. Available at: https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper14-04.pdf

Box 6: Strategies for dealing with data gaps in assessments

- **Balfour Beatty:** in undertaking a biodiversity net gain assessment, the company found key gaps in ecosystem service dependency and valuation data. They addressed this by recognizing and disclosing data limitations and their implications for decision-making, using the assessment to inform, rather than define, the decision made.
- **BASF:** in using natural capital assessments to communicate with stakeholders, BASF recognized the limitations of the data being used, also using it to inform, rather than to set, decisions.

- **Lack of capacity to deliver fit-for-purpose data for decision-making.** One of the causal factors of the data challenges and gaps above is the fact that, typically, the data being used in natural capital assessments has not been produced specifically for that purpose. Often the data has been produced for, or derived from, other related processes and systems and is retro-fitted to the natural capital assessment. Therefore, there is a need to bring data providers together with data users to better understand the data needs and intended uses, and to explore how the challenges above can be addressed.

Potential solutions: building capacity

A quick win to address capacity needs is to ensure that finance teams are closely engaged with natural capital assessment processes to provide data handling guidance and knowledge transfer.

Capacity needs' assessments across the natural capital data ecosystem would be valuable to aid our understanding of how to improve data quality, completeness, and uptake. It would also help in communicating with data users/analyzers to ensure data limitations are understood and factored into decisions. A combination of training, published case studies, and peer-to-peer knowledge exchange could assist with this (see Table 5).

Table 5: Potential solutions to data-related challenges encountered in natural capital assessments.

	Potential solution	Description
Quick wins	**Engagement of finance/audit professionals in assessments**	Bring the skills of finance teams into natural capital assessments from the 'Frame' stage, ensuring their engagement in data issues.
Quick wins	**Checklist of data characteristics for data filtering**	Data checklist of key data characteristics to assist sustainability teams to filter the available data to meet the needs of their natural capital assessments in the context of their business needs.
Long-term action	**Published case studies**	Case studies on data gathering, analysis, and integration into decision-making will help build understanding of data issues, how to overcome them, and their implications for decision-making.
Long-term action	**Capacity building and training**	Capacity development throughout the data ecosystem, from data collector (to ensure robust and repeatable measurement), to data collator (to ensure errors are avoided and emerging technologies for data collection are understood and used), and to data users/analyzers (to ensure data limitations are understood and factored into decisions).
Long-term action	**Members of the data ecosystem convened**	Data collectors, tool developers, and end users brought together to build a mutual understanding of needs, and to build a new generation of tools and data that can better inform natural capital assessments.
Long-term action	**Integrate data considerations into all projects**	Consider data needs in all sector guidance[15] and projects, consulting with data providers and users to ensure data guidance is included, and to start building capacity of those two parties to understand data issues and deliver against user needs.

[15] https://naturalcapitalcoalition.org/sector-guides/

Bringing members of the data ecosystem together to define and deliver the key solutions outlined within this document could help to build mutual understanding of data constraints, needs, and how to address them.

To address the disconnects in the data ecosystem – between users, collators, and providers etc. – that give rise to the challenges outlined above, its constituent groups should be convened. Key groups to convene in order to facilitate this understanding include:

- **Business and national/government data users.** Businesses are currently drawing from government-funded and -generated datasets, but these are often at resolutions that are not directly useful for companies. Within this group, the need has been expressed for spatially-explicit resources, and to develop a good understanding of local-level processes. National-level SEEA (System of Environmental-Economic Accounting) databases (used primarily by governments) are spatially explicit and could offer the information required by business for natural capital assessments. Bringing these two groups together as part of the Combining Forces work program could increase access to data within the private sector and facilitate the production of more locally-relevant spatial data by national decision makers.
- **Data providers with users.** This could ensure that data, tools, and metrics are more relevant to business and become more valuable for the decisions that they are needed to inform. By ensuring all protocol supplement developers are aware of these data issues and work to address them in their guidance, engaging different groups from across the data ecosystem in guidance development should start to address this issue.
- **Data providers and collators with data standard-setters.** This could start to build more consistency in data classification and terminology, and to increase the quality of datasets generated for use in natural capital assessments.

Next steps

The Data Information Flow project brought the natural capital community together to build consensus on the barriers disrupting the flow of information through the data ecosystem. As a result we now have a framework to categorize and address these challenges. This section outlines our next steps and the actions we can take forward as a community.

Quick wins for companies

As well as the quick wins we have outlined, the report also sets out three case studies to illustrate some of the approaches businesses are taking to overcome data challenges. A further output includes guidance that can be drawn on when undertaking a natural capital assessment.

What's next?

Building on this first phase, data considerations and potential solutions will be integrated into all of the Coalition's ongoing projects and capacity building activities. Central to this will be convening actors from across the data ecosystem to improve communication and co-create solutions. In particular the Coalition's Natural Capital Regional Platforms provide an excellent opportunity to bring together different stakeholder groups around common issues.

The Coalition's Combining Forces project will also work to develop data case studies and share examples of best practice. Through identifying and facilitating these case studies, strategies to address specific challenges can also be explored. These areas could include incentives for data sharing, harmonizing measurement methodologies, and testing how technology can be used to reduce error and fill data gaps.

These actions can be facilitated by the following outputs:

- Collaborative development of a data lexicon. This lexicon will agree terms and definitions, building consistency from providers through to users.
- A data checklist, including key data characteristics that users should look for to help them filter available data for their own needs. This can be integrated into the Coalition's ongoing projects, with the addition of more specific advice for particular sectors or relevant issues.
- Making existing data guidance and key datasets as accessible as possible. This can be achieved through integration into the MIT Shift platform- the new home of the Natural Capital Protocol Toolkit.

We look forward to working with you to improve the flow of data to information across the system.

[16] https://shift.tools/

Annexes

Annex 1: Project approach

Objectives

The Data Information Flow project seeks to facilitate the use of better data to support natural capital assessments by:

1. Defining business needs around natural capital data
2. Determining the extent to which existing natural capital data meet these needs
3. Identifying the barriers that limit the use of data for business needs
4. Identifying the solutions required to address the barriers to improve the utility, accessibility, quality, consistency, completeness and comparability of natural capital data
5. Bringing together the data producers, collators, funders, and users to create and disseminate resources to address the fundamental barriers to natural capital decision-making

Outcomes

Through working collaboratively with a range of stakeholders, this project will deliver:

- Better clarity and harmonization within the data ecosystem, based on better, more accessible data for natural capital application; and
- Better communication between stakeholder groups, such as data producers, data collators, funders, governments and business users.

Background

This project seeks to bring together data users, providers, funders, academics and others with data interests, to explore key data questions relating to natural capital assessments over four project phases (see Figure 9 below). This report is a key output from the first phase of work.

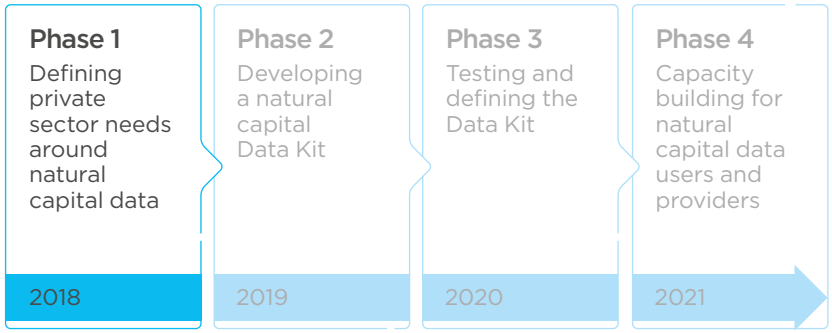


Figure 9
The four planned phases of the natural capital Data Information Flow project.

Approach

This first phase of the project combined a review of published and unpublished literature relating to data, data standards and guidance and a survey of Natural Capital Coalition members to explore current use of natural capital data and seek feedback on data challenges and potential solutions. Structured interviews were conducted with 10 stakeholders from different elements of the data ecosystem.

Literature review

Through the Natural Capital Coalition's outreach, projects and programs over the past three years, much information has been collated on the data challenges encountered in natural capital assessment processes. The sources of information that were reviewed for examples and experiences of data challenges faced by those seeking to assess their natural capital impacts and dependencies were:

- Pullin, N. Unpublished. How business is mainstreaming natural capital: a study with and for business on how they are approaching their natural capital assessments. Imperial College London.
- Natural Capital Coalition. 2017. This is natural capital 2017.
- Natural Capital Coalition. Unpublished. Natural Capital Protocol Application Program.
- WBCSD. Unpublished. Summary of challenges faced by six companies applying the 'Frame' and 'Scope' stages of the Natural Capital Protocol. (Available upon request).
- Natural Capital Coalition. In prep. Applying the Natural Capital Protocol: Nespresso coffee production in Colombia.
- Natural Capital Coalition. 2016. Business insights: pilot testing the Natural Capital Protocol. Available at: www.naturalcapitalcoalition.org/business-insights-pilot-testing-the-natural-capital-protocol.
- Natural Capital Coalition. Unpublished. Data for natural capital assessments: needs, challenges and opportunities. Natural Capital Coalition member event feedback (meeting 26 June 2015).

Stakeholder survey

A survey was conducted to identify barriers and challenges associated with the use of natural capital data, and to identify opportunities for targeted guidance on data issues. Respondents were asked questions relating to natural capital assessments under four major themes: 1) the use of natural capital data; 2) sources of natural capital data; 3) where data gaps and challenges occur; and, 4) where data guidance and support could improve assessment processes.

The survey was distributed through the Natural Capital Coalition's data mailing list, made up of those expressing interests in the Data Information Flow project through the Coalition's website (1,183 at the time of the survey). It was also publicized through their social media streams. The survey was open for responses between 28th June and 23rd July 2018.

Important results were selected through observation of trends and anomalies within frequency data produced in each question. A secondary reviewer assessed the data and validated results to eliminate the effect of observer bias.

The survey yielded 120 responses from more than 70 organizations; 66% of which stated that they are actively engaged in natural capital assessments. The majority of respondents were located in Europe, and they mostly identified themselves as members of consultancies, businesses with >250 employees, or Non-Governmental Organizations with a societal or conservation focus. The respondents most frequently occupied positions in environmental or sustainability teams. Figure 10 shows the space that respondents felt they occupied in the data ecosystem. More than 70% of respondents saw the role of their organizations as 'data interpreters/analyzers' or 'data users', with less than 30% identifying as 'data providers', and less that 15% as 'data funders'.

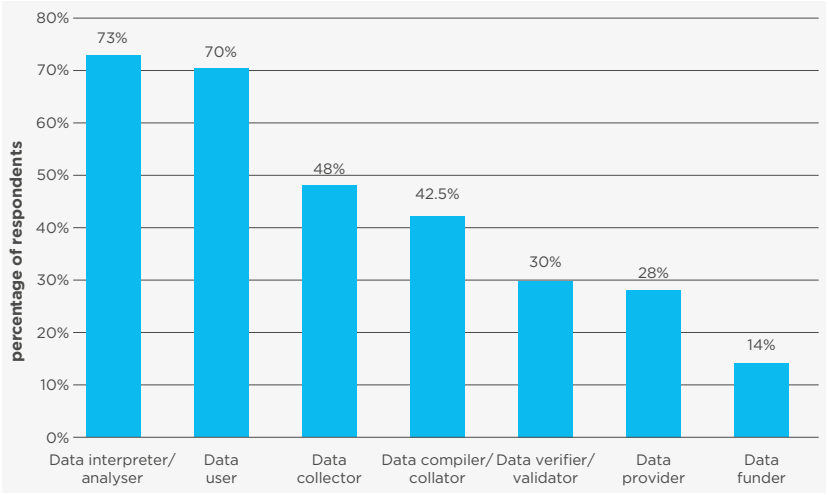


Figure 10
Respondent perception of organizational roles within the data ecosystem.

The vast majority (87%) of respondents indicated that they **require more guidance on data use in natural capital assessments**. Respondents indicated that the areas where additional guidance is most needed are: addressing data gaps, identifying consistent methodologies for data collection, sources of data, and data quality (see Table 6). 'Biodiversity' and 'water' were selected as the data categories most in need of additional guidance.

Table 6: Data application areas where guidance is most needed, as identified by survey respondents. Numbers indicate the tally of selections per resource or function (columns) and guidance type (rows). Dark green indicates the least selected options; dark red indicates the most selected options.

	Biodiversity	Water	Effluents and wastes	Materials	Energy	Emissions	Other
Consistent methodologies	28	18	15	14	14	13	1
Addressing data gaps	29	17	12	16	14	10	1
Data quality	27	17	12	13	13	11	2
Sources of data	26	16	10	13	9	10	1
Setting baselines	26	13	12	9	12	9	0
Uncertainty/sensitivity	20	14	13	11	9	12	1
Data presentation	14	10	8	7	10	8	1
Making baseline adjustments	15	5	5	5	5	5	0
Acquisitions/mergers	9	7	7	5	5	6	0
Other	0	0	0	0	1	0	2
Total	**194**	**117**	**94**	**93**	**92**	**84**	**9**

Interviews

Structured interviews were conducted with individuals representing different stakeholder groups and different elements of the data ecosystem. See Table 7 below.

Table 7: List of interviewees

Name	Organization	Stakeholder Group
Bram Edens	UN Statistics Division	International Organization
Chris Zerlaut	SAP	Business
Christian Heller	BASF	Business
Jeni Tennison	ODI	NGO
Julia Baker	Balfour Beatty	Business
Julia Chatterton	Unilever	Business
Mikkel Kallesoe	FMO	Finance
Paula Harrison	Center for Ecology and Hydrology	Research and academia
Peter Alele	Vital Signs	NGO
Will Evison	PWC	Consultancy

Annex 2 – case studies

Case Study 1

FMO – analyzing environmental, social and governance risk

The Company in Brief

FMO (the Dutch development bank) is a public-private partnership with 51% of its shares in the Dutch State and 49% held by commercial banks, trade unions and other members of the private sector. Its priority sectors are the energy sector, agri-food, and water. By providing capital, knowledge, and networks, it supports sustainable growth.

What decision did the Natural Capital Assessment inform?

Assessment of environmental, social and governance risks associated with investment decisions, largely at the contract stage (hence largely based on estimates).

What guidance and data was used?

The International Finance Corporation (IFC) Performance Standard Performance Standard 6 'Biodiversity Conservation and Sustainable Management of Living Natural Resources'. See Figure 11 for data sources.

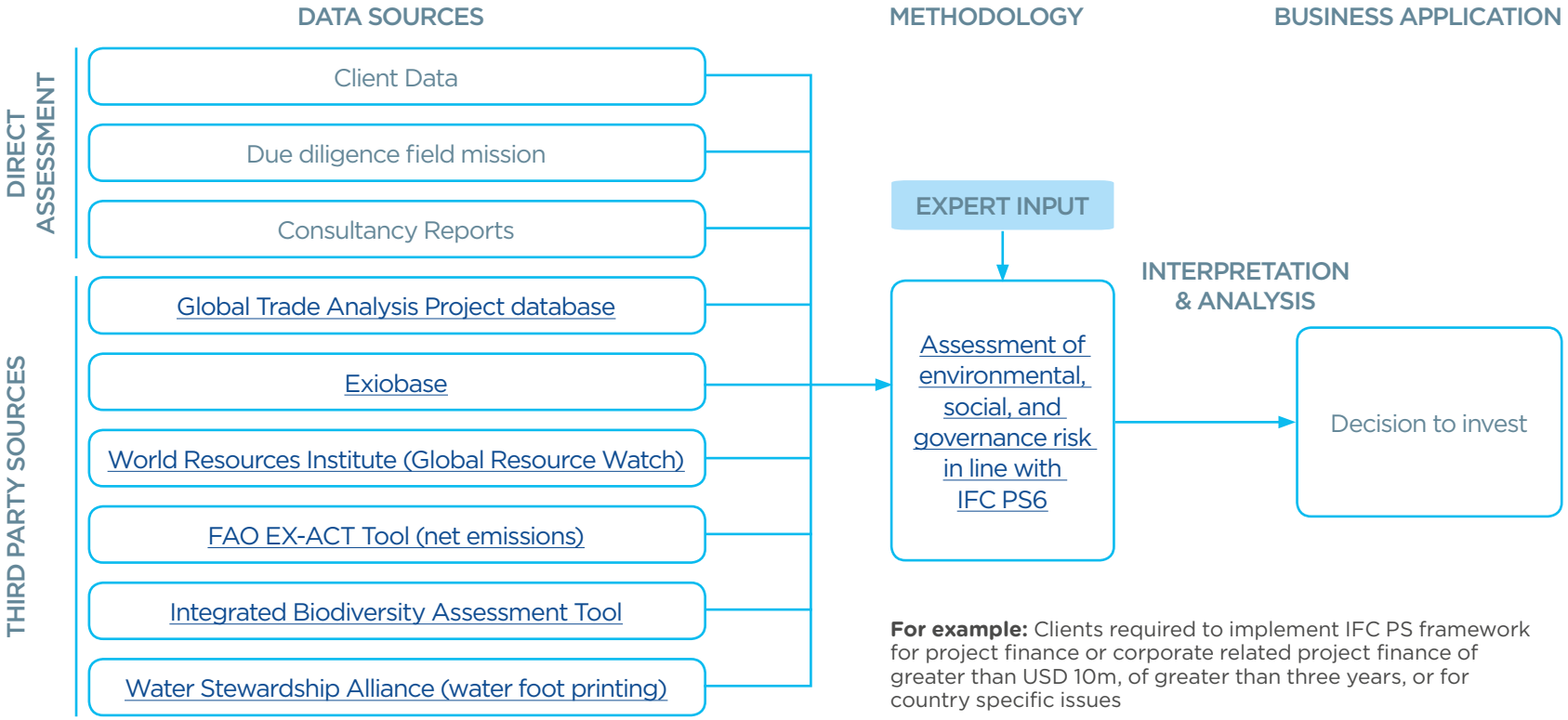


Figure 11
Data sources used by FMO in undertaking a natural capital assessment.

Case Study 2

BASF – valuing impact in the chemical sector

The Company in Brief

BASF is the largest chemical producer in the world. Headquartered in Germany, it has subsidiaries and joint ventures in more than 80 countries. Its product portfolio ranges from chemicals, plastics, performance products, and crop protection products, to oil and gas.

What decision did the natural capital assessment inform?

Quantification and valuation of BASF's impacts was used to inform decision-making and improve communication of the company's activities and value to its stakeholders.

What guidance and data was used?

PWC's Total Impact Measurement Management (TIMM) framework with the Natural Capital Protocol as a support tool. Data sources used are outlined in Figure 12.

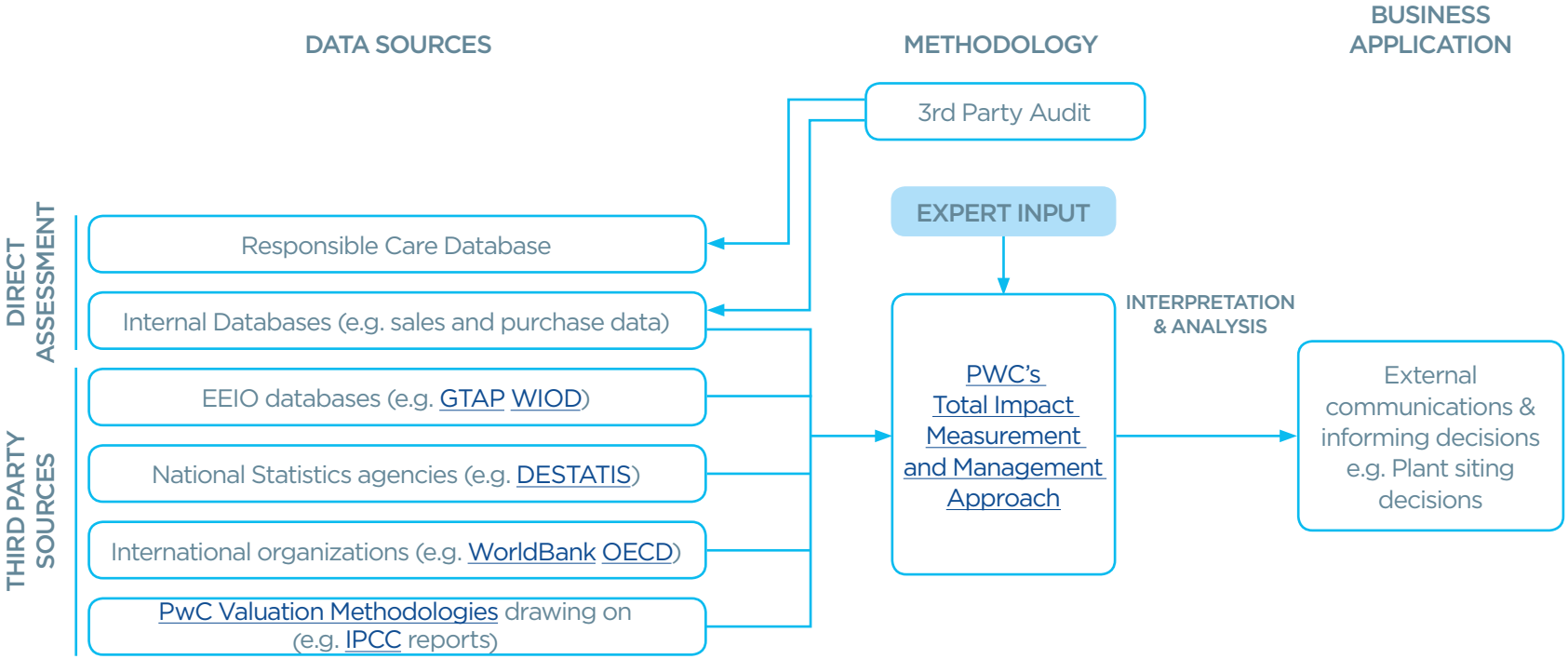


Figure 12
Data sources used by BASF in undertaking a natural capital assessment.

Case Study 3

Balfour Beatty – delivering biodiversity net gain in construction

The Company in Brief

Balfour Beatty is an international construction company that finances, designs, project manages, and maintains infrastructure assets.
The company operates in the UK, Ireland, USA and the Far East. This case study focuses on UK-based infrastructure for which Balfour Beatty is supporting clients to deliver biodiversity net gain.

What decision did the Natural Capital Assessment inform?

Quantification of ecosystem services and assignment of monetary values to inform a decision on maximizing wider environmental and social benefits after biodiversity net gain has been achieved.

What guidance and data was used?

Corporate Natural Capital Accounting Framework backed up by the Natural Capital Protocol as a reference source. See Figure 13 for data sources.

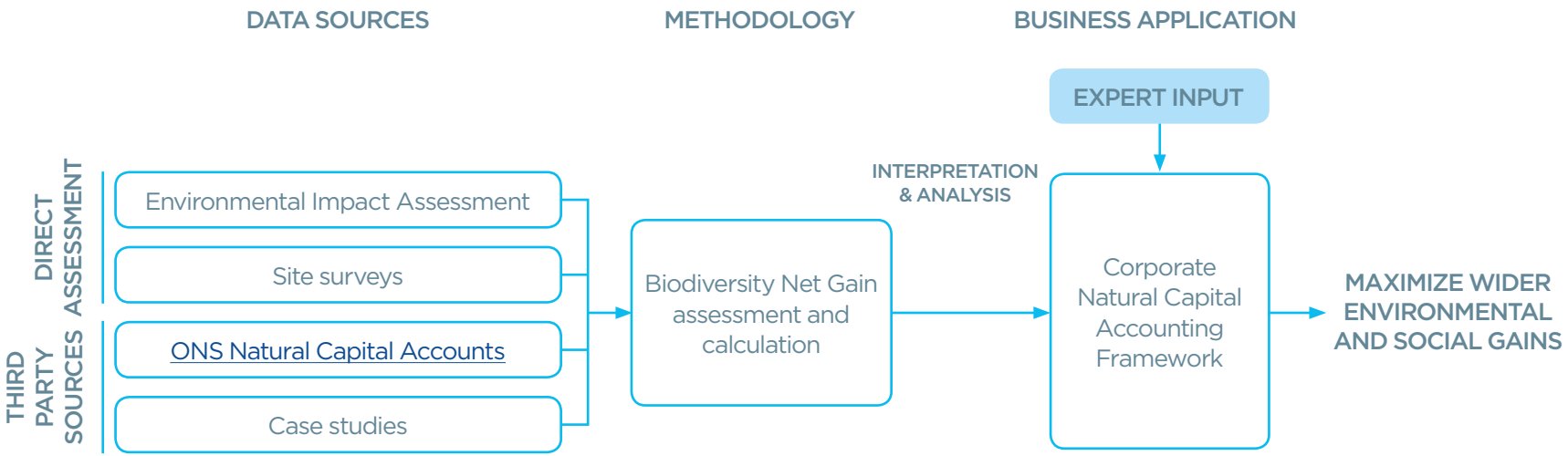


Figure 13
Data sources used by Balfour Beatty in undertaking a natural capital assessment.

Annex 3: Review of guidance on data standards, management, and quality

This annex to the report 'Data use in natural capital assessments: assessing challenges and identifying solutions' forms part of phase 1 of the Data Information Flow project, delivered by the UN Environment World Conservation Monitoring Centre (UNEP-WCMC), on behalf of the Natural Capital Coalition. The table below provides a summary of sources of data-related guidance identified as a result of desk-based research, a stakeholder survey, and structured interviews with 10 organizations representing different aspects of the natural capital data ecosystem. This review seeks to assist companies in dealing with the data challenges they face when carrying out natural capital assessments.

	Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
Generic guidance on data standards, management and quality					
1.1	DataONE Best Practices **– Data Observations Network of Earth**	Researchers	A searchable database on best practices in data management aimed at the research community. It is accompanied by a primer on data management which contains hyperlinks to best practices within the database. The best practices are often brief and are aimed at researchers rather than business, but provide a good introduction to a diverse range of concepts including developing a data management plan.	Accessibility Infrastructure Quality	Relevant for all issues
1.2	INSPIRE Data Standards **– European Commission**	Governments	An infrastructure for environmental spatial data developed for use in the European Union, but with broader applicability to companies wishing to adopt a pre-defined set of standards for managing data. Aims to enhance interoperability and optimize data-management processes. Companies adopting it will be able to draw on a large quantity of interoperable data from EU governments. May not always be useful to a non-specialist audience.	Quality Infrastructure	Relevant for all issues
1.3	Fundamental Principles of Official Statistics, **2014 – United Nations Statistics Division**	Governments	10 Principles to guide official statistics organizations in the collection, review, storage and representation of relevant data. It addresses: methods of collecting data, transparency, dealing with errors in data, data sources, confidentiality, creating a strong data ecosystem.	Quality Infrastructure	Relevant for all issues
1.4	Guidelines for the Template for a General National Quality Assurance Framework, **2012 – United Nations Stats**	Governments	A document to support the template for a National Quality Assurance Framework (NQAF). It outlines quality assurance procedures as well as ways in which quality can be assessed and reported on. It covers how accessibility, accuracy, reliability, security, and confidentiality of data should be managed. It also addresses how interactions between data providers, data users, and national statistical organizations should be conducted.	Quality	Relevant for all issues

Name		Primary user	Description	Challenge(s) addressed	Impact/ Dependency
1.5	The principles of good data management, **2005 – UK Ministry of Housing, Communities and Local Government**	Governments	This document is intended for use by the UK government, but is also relevant to businesses. It provides guidance on the principles of geographic data management, but is potentially useful for other types of data. Additionally, the document lays out principles that touch on ownership, metadata, quality, data management plans, and data-sharing, however, it does not go into detail.	Quality Infrastructure	Relevant for all issues
1.6	Handbook on Data Quality Assessment Methods and Tools, **2007 – European Commission**	Governments, Data Providers	Describes how to conduct a data quality assessment and aims to help users determine whether a decision can be made with the required confidence, and whether the sampling design is adequate to support future assessments. The document lays out five steps, including sampling design, verifying the assumptions of a selected statistical test, and drawing conclusions. It is highly technical and therefore may not be accessible to many private sector users. The DataQUEST software referred to in the document is no longer available.	Quality (dealing with uncertainty)	Relevant for all issues
1.7	Pedigree Matrix, **2007 – Swiss Centre for Life Cycle Inventories**	Business	A methodology for qualitatively assessing uncertainty of data in life cycle assessments. It uses a suite of 5 indicators, reliability, completeness, temporal correlation, geographical correlation and further technical correlation to determine the uncertainty of data.	Capacity (dealing with uncertainty)	Relevant for all issues
1.8	Motivating and improving uncertainty assessment in ecosystem services modelling to inform decisions, **2016 – Natural Capital Project, Stanford**	Businesses, Governments, NGOs	Presents the results of a workshop on the current state of practice on uncertainty assessment. Although parts of the workshop report will not be relevant to business users, it provides an overview of the key issues around uncertainty as it relates to ecosystem service assessments. It goes on to discuss specific techniques and tools for dealing with uncertainty.	Capacity (dealing with uncertainty)	Relevant for all issues
1.9	Uncertainty assessment in ecosystem services analyses: Seven challenges and practical responses, **2017 – Journal of Ecosystem Services**	Businesses, Governments, NGOs	This article discusses approaches to dealing with uncertainty, and challenges specific to ecosystem services assessments. Table 1 lists specific challenges and concerns, and provides suggestions for practical solutions in each case.	Capacity (dealing with uncertainty)	Relevant for all issues

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
1.10 Guidance for Uncertainty Assessment and Communication Series – **Netherlands Environmental Assessment Agency**	Governments	Guidance in multiple volumes: • Guidance for uncertainty assessment and communication, 2013 • Guide for uncertainty communication, 2013 • Guidance for uncertainty assessment and communication: detailed guidance, 2003 • Guidance for uncertainty assessment and communication: tool catalogue for uncertainty assessment, 2004 • Guidance for uncertainty assessment and communication: checklist for uncertainty in spatial information and visualizing spatial uncertainty, 2006 It covers how to take uncertainty into account when drawing conclusions and how to communicate it to users. Included are tools for in-depth assessments of uncertainty, as well as methods for identifying intended audiences and tailoring communication to them.	Capacity (dealing with uncertainty)	Relevant for all issues
1.11 Monte Carlo Simulation – **Palisade**	Multiple	Outlines application of Monte Carlo simulations for understanding the uncertainty within a model based on the data used. Using the minimum and maximum estimated values the data, the methodology helps identify the most likely output of a model.	Capacity (dealing with uncertainty)	Relevant for al issues
1.12 Open Data Institute (ODI) – **Open Data Institute**	Businesses, Governments	ODI provides resources and services to help users manage their data, including guidance on data infrastructure, ethics, and publishing. Guidance on mapping the data ecosystem to determine flows of information and how best to manage them.	Infrastructure	Relevant for all issues
1.13 Open Geospatial Consortium (OGC) standards and supporting documents – **OpenGeospatial**	Businesses	This is a series of technical documents detailing interfaces and encodings. When implemented, the standards improve interoperability between products and/or online services. The standards are accompanied by a set of best practice documents which can be found here. The use of these standards requires specialist knowledge hence they will be useful primarily for data providers.	Infrastructure	Relevant for all issues but focus on spatial data

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
Guidance on data directly relevant to natural capital assessments				
2.1 Improving EIA practice: Best practice guide for publishing primary biodiversity data, 2011 **– Global Biodiversity Information Facility**	Businesses	Guide promoting standards and data publishing tools which can be used by those undertaking Environmental Impact Assessments to discover, capture and publish biodiversity data in a standardized format. This includes developing a set of best practices and standards; developing data-transformation tools; and promoting the use of local and global information systems and networks	Accessibility Infrastructure	Relevant for all issues
2.2 Toolkit for Ecosystem Service Site-based Assessment (TESSA)	Businesses, Governments, NGOs	Provides practical guidance on how to assess and monitor the flows of ecosystem services and some of the stocks of natural capital at a site scale. The toolkit uses a step-by-step framework to guide users with identifying which services to assess, what data is needed to measure them, what methods or sources can be used to obtain the data and how to communicate the results. The toolkit focuses on site scale assessments making it useful for local decision-making and it is accessible to non-experts and conservation practitioners on the ground. However, some relevant experience or training may be necessary.	Accessibility Capacity Quality	Relevant for all issues

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.3 The System of Environmental-Economic Accounting (SEEA), 2012 – **United Nations Statistics Division**	Governments	A framework that includes internationally agreed standards and accounting rules for producing statistics on the environment and its relationship with the economy. This includes guidance on integrating economic, environmental and social data to support decision-making. Important resources include: • Central Framework providing a comprehensive set of accounts and guidance on understanding the interactions between economy and environment. • Applications and Extensions (building on the Central Framework to provide examples of possible uses of SEEA data for policy and research) • E-learning courses including on water accounts, with other impact areas in development (requiring enrolment) The SEEA has specific sub-systems on: Energy, Water, Land and Ecosystems and Agriculture, forestry and fisheries. The SEEA for water is the most developed and is supported by the International Recommendations for Water Statistics (see 2.24). The SEEA for energy and the SEEA for agriculture, forestry and fisheries are in draft form, and up-to-date information is not available on the website. The SEEA Experimental Ecosystem Accounts deal with land and ecosystems. This is not an official standard but more a conceptual framework informed by the current state of the art. There is an ongoing revision process to achieve an official statistical standard for the SEEA EEA by 2020. The SEEA EEA is a rather broad conceptual framework and does not go into detail on the data issues. However, data is addressed in the form of advice on spatial data infrastructures in the technical recommendations for the SEEA EEA.	Accessibility Capacity Infrastructure	Relevant for all issues
2.4 Technical Recommendations in support of the System of Environmental-Economic Accounting, **2012 – United Nations Committee of Experts on Environmental-Economic Accounting**	Businesses	A document providing support for the testing of ecosystem accounting in the light of the publication of SEEA (2.3). There are resources for collating and managing the data needed to carry out ecosystem accounting. It also provides information on a range of data sources as well as methods for carrying out ecosystem accounting.	Accessibility Capacity Infrastructure	Relevant for all issues

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.5 Natural Capital Assessments at the National and Sub-national level. A guide for environmental practitioners, **2016 – United Nations Environment**	Governments	Presents eight steps to completing natural Capital Assessments. The third step is to 'Gather and review data'. This outlines key principles and practices for collection, processing and using data to ensure that they are accepted by stakeholders and decision makers and that they can be updated and further synthesized in a standard format.	Accessibility Capacity Quality	Relevant for all issues
2.6 Natural Capital Protocol, 2016 **– Natural Capital Coalition**	Businesses	Guides businesses through the process of undertaking a natural capital assessment. It includes basic guidance on dealing with uncertainty around outcomes, including probability-based analysis, multi-criteria analysis, expert opinion and/or multi-stakeholder assessment. Section 7 describes how to use value transfer while minimizing limitations and sources of error. Section 8 includes information on testing assumptions. The protocol further discusses how to verify whether the results of an assessment are robust enough to base decisions on, and/or to be communicated externally.	Capacity	Relevant for all issues
2.7 Developing Corporate Natural Capital Accounts, **2015 – Natural Capital Committee, EFTEC, RSPB, PWC**	Businesses	This document provides a framework to develop natural capital accounts. It aims to produce an easily understandable Natural Capital Balance Sheet for an organization. It also details pilot studies with varying levels of data from a range of sources. Can assist companies in determining the sorts of data required in natural capital assessments.	Capacity	Relevant for all issues
2.8 Guidelines for Environmental & Social Impact Assessment, **2016 – The Cement Sustainability Initiative**	Businesses	This document provides guidelines on how to identify impacts and dependencies, as well as measure changes in natural capital. It outlines what data should be collected in order to assess impacts.	Capacity	Relevant for all issues

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.9 International Organization for Standardization Standards – **International Organizations for Standardization**	Businesses, Data Providers, Governments, NGOs	Provides guidance on data standards applicable to a wide range of sectors. Many of these standards are relevant to environmental data. An ISO standard for the valuation of natural capital is in development, and will be published in 2019. Further information can be found here. Although globally accepted, much of the guidance is behind a paywall and were therefore not reviewed in detail. Relevant introductory pages include: • Environmental management • Environmental management: quantitative environmental information: guidelines and examples • Environmental management: life cycle assessment: principles and framework • Environmental management: material flow cost accounting: guidance for practical implementation in a supply chainhttps://www.iso.org/standard/54811.html • Environmental management: water footprint: principles, requirements and guidelines • Protecting our planet: https://www.iso.org/protecting-our-planet.html • Geographic information: metadata: part 1: fundamentals	Quality Infrastructure	Relevant for all issues
2.10 Data Quality Assessment: A Reviewer's Guide, **2006 – US Environmental Protection Agency**	Governments	Contains guidance on determining whether environmental data are suitable for a given purpose. It helps address questions around sampling design, uncertainty and whether a decision can be made given the quality of the data. It includes sections on aligning data-sampling design with objectives, conducting a data-review, selecting statistical methods, drawing conclusions and interpreting the results.	Quality (gaps and uncertainty)	Relevant for all issues

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.11 Biodiversity Conservation Information System (BCIS) Framework for information sharing, **2000 – United Nations Environment Programme World Conservation Monitoring Centre**	Businesses, Data Providers, Governments, NGOs	This series of documents aims to promote understanding of key data-management principles and the process of implementing an organizational data policy. The series includes guidance on quality assurance, principles of maintaining metadata, data standards and data management tools including a subsection on database design. Volume 7 on core datasets is no longer up-to-date and therefore, doesn't remain useful. Volume 4 on data access does not discuss more recent developments in this field, but does address data approaches and principles that remain relevant and useful. If used, the series should be referred to in combination with more recent guidance.	Quality Infrastructure	Relevant for all but with a focus on biodiversity
2.12 Approaches to mapping ecosystem services, **2016 – United Nations Environment Programme World Conservation Monitoring Centre**	Businesses, Governments	Provides guidance on different types of input data, mapping methods, mapping at different scales and mapping tools. It also discusses key challenges in mapping projects, and how to go from mapping to decision-making, although this section does not go into detail.	Capacity	Relevant for all issues–spatial data
2.13 Environmental Impact Assessment Biodiversity Data Publishing Framework, **2012 – Journal of Impact Assessment and Project Appraisal**	Businesses, Governments	Scientific paper highlighting the lack of accessibility to biodiversity information obtained during environmental impact assessments and sets out an EIA Biodiversity Data Publishing framework, based on the Global Biodiversity Information Facility (GBIF) global standards.	Accessibility	Biodiversity
2.14 Principles of Data Quality, **2005 – Global Biodiversity Information Facility**	Data providers	This document deals primarily with the quality of species occurrence data, but has broader applicability, dealing with general principles of data accuracy and precision, quality-assurance, quality-control, uncertainty and error.	Quality	Biodiversity
2.15 Principles and methods of data cleaning, **2005 – Global Biodiversity Information Facility**	Data providers	Although focused on species occurrence data, this document contains relevant sections on error-prevention and cleaning of spatial and descriptive data. It includes a section on documentation of error and error-checking, enabling users to determine the 'fitness of use' of the data. Lastly, it provides a list of software packages that can aid in enhancing data quality and addressing error.	Quality	Biodiversity

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.16 National Biodiversity Network guidance documents – **National Biodiversity Network**	Data providers	Provide flexible standards on collecting wildlife data. They include guidance on planning surveys, recording data, managing data, and making use of data. Some details are UK-specific, but much of the content has broader applicability.	Infrastructure	Biodiversity
2.17 Data sharing for sustainable assessments: Using functional databases for interoperating multiple building information structures, **2012 – Conference Paper**	Businesses, Data Providers	This study investigates the development and implementation of an automatic sustainable assessment prototype using functional databases. They translate rules from the Leadership in Energy and Environmental Design (LEED) standard into computable formulas and develop a prototype application to produce templates for LEED submission. It provides useful information on the use of computer systems or software to exchange and make use of information and create semi-automated evaluation for use in assessments.	Infrastructure	Energy Greenhouse gas Water Waste
2.18 Global Logistics Emissions Council Framework, **2016 – Smart Freight Centre**	Businesses	A framework for assessing the greenhouse gas footprint of businesses in the freight sector. Enables the identification of impacts related to GHG emissions and energy dependencies but does not attempt to value these. There is guidance on how to address data needs and manage computer systems to handle the most accurate emissions data.	Capacity	Greenhouse gas emissions
2.19 Uncertainty in greenhouse gas inventories, **2007 – International Institute of Applied Systems Analysis**	Government	This brief introduces the concept of uncertainty in inventories of greenhouse gas emissions and removals. It discusses uncertainty analysis and the possibility of pricing uncertainty, and provides links to further information.	Capacity (dealing with uncertainty)	Greenhouse gas emissions
2.20 Sub-national consumption statistics: Methodology and Guidance, **2018 – Department for Business, Energy & Industrial Strategy, UK**	Businesses Government	Guidance provided on the use and interpretation of energy consumption statistics. It provides information on limitations and comparability of statistics for gas, electricity, road transport fuels and residual fuels.	Capacity	Greenhouse gas emissions

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.21 Guidance on how to measure and report your greenhouse gas emissions, **2009 – Department for Environment, Food and Rural Affairs, UK**	Businesses	Guidance on measuring organizational greenhouse gas emissions. Includes data requirements for calculations, methods for conducting assessment and how to verify emissions data.	Capacity	Greenhouse gas emissions
2.22 Valuing corporate environmental impacts: PwC methodology document, **2015 – PriceWaterhouseCooper**	Businesses	A series of seven papers present the approach taken by PricewaterhouseCoopers to the valuation of environmental impacts for Environmental Profit and Loss Accounts. Topics covered include pollution (air and water), solid waste, greenhouse gases, land use, and water consumption. The third paper describes impacts of land use change and the data needed to estimate the consequences in terms of lost ecosystem services. Guidance is provided on the types of data that might be available, potential sources of data and coefficients and provides guidance on sensitivity analysis.	Capacity Quality	Greenhouse gas emissions Land use Waste Water
2.23 Economics of Land Degradation Initiative: User Guide, **2015 – Economics of Land Degradation Initiative**	Businesses, NGOs, Governments	The document outlines a 7 step process for the implementation of cost benefit analysis for land use change scenarios. There is a breakdown of suggested approaches (and the required data collection) for assessing different ecosystem services, as well as the ease with which this can be done.	Capacity	Land use
2.24 Economics of Land Degradation Initiative: Practitioners Guide, **2014 – Economics of Land Degradation Initiative**	Businesses, NGOs, Governments.	Based on the principles set out in the 2.23. This document guides users through the process of conducting a cost-benefit analysis with regards to the avoidance of land degradation. It summarizes a range of methods for collecting data in order to value ecosystem services associated with changes in land use	Capacity	Land use
2.25 Corporate water accounting: an analysis of methods and tools for measuring water use and its impacts, **2010 – United Nations Environment**	Businesses	Includes descriptions of a range of water accounting methods and tools, including the type of data required. It also has a section on data limitations, describing the implications of the limitations on a business's ability to arrive at meaningful conclusions.	Capacity Quality	Water

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.26 International Recommendations for Water Statistics (IRWS), **2012 – Knowledge Base on Economic Statistics**	Governments	Principles to ensure that water data is collected and compiled on a comparable basis. This guidance aligns with the SEEA (2.3) for water. Can be used by businesses, researchers, compilers of water accounts, and the public. Includes guidance on physical and monetary data types relating to stocks and flows; inland waters; and population using improved water sources and sanitation facilities. Guidance is provided on statistical units and classifications, types of water-related data, data collection strategies, data sources and methods, metadata and data quality, and data dissemination. It does not include guidance on surface water and groundwater quality, drinking water quality, environmental flows or social aspects of water. Marine water resources are considered only when they relate to the extraction of saltwater from the sea.	Quality Infrastructure	Water
2.27 ISO and water, **2017 – International Organization for Standardizations**	Businesses, Data Providers, Governments, NGOs	This document provides an inventory of the ISO standards relating to water.	Infrastructure	Water
2.28 The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, **2015 – World Business Council for Sustainable Development**	Businesses	Provides standards and guidance to businesses and others preparing a greenhouse gas inventory, including accounting and reporting processes. This Standard is accompanied by: Greenhouse Gas Protocol Scope 2 Guidance, 2015: this amendment to the Standard adds information on new requirements.	Infrastructure Quality	Greenhouse gas emissions

Name	Primary user	Description	Challenge(s) addressed	Impact/ Dependency
2.29 **GRI Standards –** Global Reporting Initiative	Businesses	Provides standards for reporting on impacts and how they are managed. Each of the following documents should be used alongside the three universal Global Reporting Initiative Standards available at the same link: Standards 301 – Materials (2016) Standards 302 – Energy (2016) Standards 303 – Water and Effluents (2018) Standards 304 – Biodiversity (2016) Standards 305 – Emissions (2016) Standards 306 – Effluents and Waste (2016) Standards 307 – Environmental Compliance (2016) Standards 308 – Supplier Environmental Assessment (2016)	Infrastructure	Biodiversity Energy Greenhouse gas emissions Waste Water