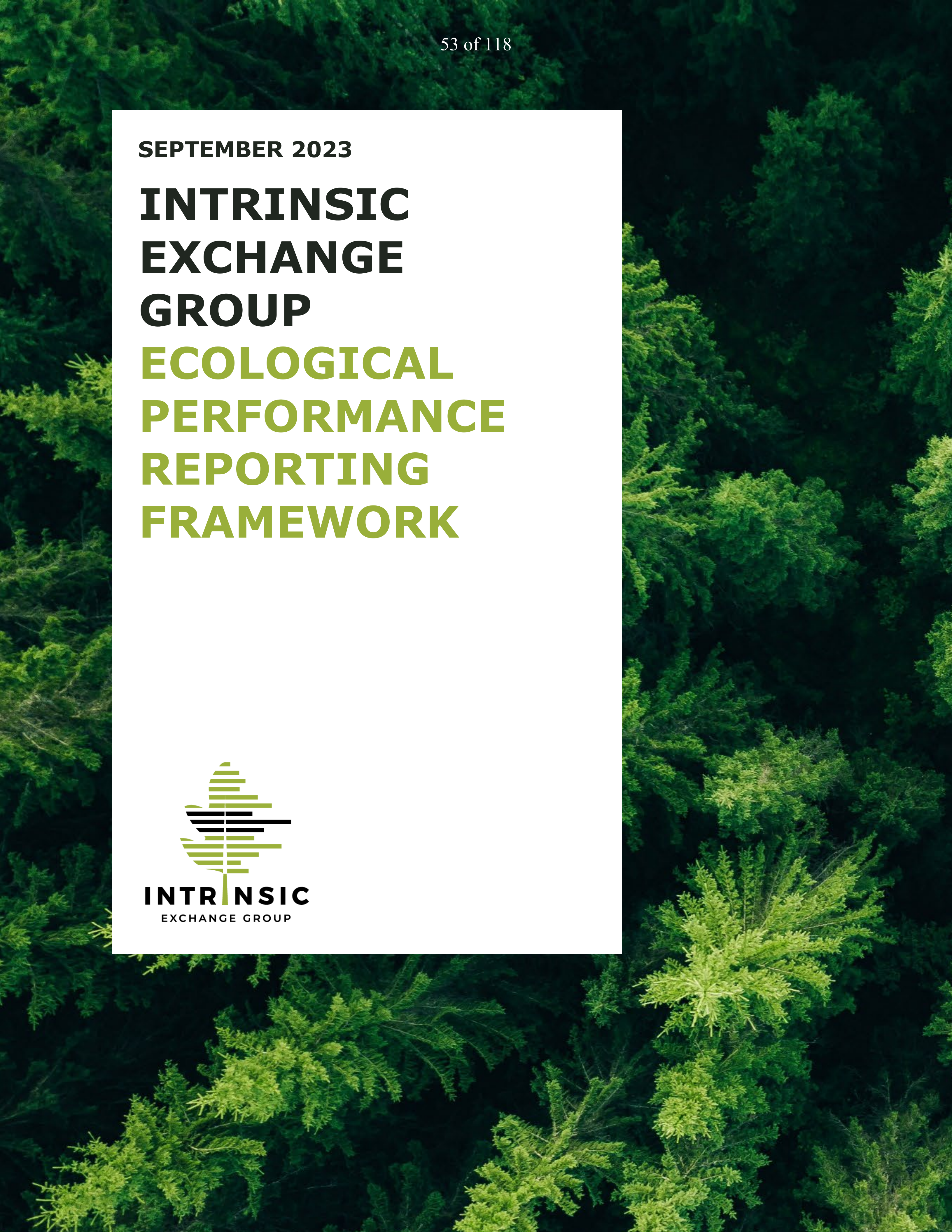

SEPTEMBER 2023

INTRINSIC EXCHANGE GROUP

ECOLOGICAL PERFORMANCE REPORTING FRAMEWORK

INTRINSIC
EXCHANGE GROUP

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PREFACE

Intrinsic Exchange Group ("IEG") has developed a new type of company, a Natural Asset Company ("NAC"), whose purpose is to actively manage and grow the value of natural assets and their production of ecosystem services, and in doing so reflect their value over time. IEG has worked with the New York Stock Exchange ("NYSE") in connection with the adoption of listing standards to permit the listing of NACs on the NYSE.

Natural assets like forests, wetlands, or grasslands, provide a wealth of goods and services to people that not only sustain economic activity but that make life on Earth possible. These goods and services are called ecosystem services and include benefits such as clean air, water, productive soils for agriculture, food, climate stability, habitat for wildlife, genetic materials, medicines, and food.

The concept of ecosystem services gained recognition globally through the Millennium Ecosystem Assessment,[1] a research effort launched by the United Nations involving more than 1,300 leading scientists from 95 nations that examined the interactions between ecosystems and human well-being. Since then, there have been significant advances in the science and understanding of ecosystem services and natural capital and the frameworks used to classify, measure, and value them.

The field of natural capital valuation has been growing as natural assets are increasingly understood as sources of value that sustain economic activity and human well-being. In 2023, the White House published a strategy to include natural capital in the national economic accounting system, defining natural capital as "the biophysical or biological elements of nature that persist through time to contribute to current or future economic production, human enjoyment or other services that people value."[2]

According to the World Economic Forum, over half of the world's GDP is moderately or highly dependent on nature.[3] Despite how essential they are, natural assets and the services they provide have been largely excluded from the mainstream of the economy.

The demand for sustainable investment is large and growing, to such a degree that demand far outstrips supply.[4] However, capital flows directed to biodiversity conservation, renewable energy, regenerative agriculture, and other direct investments needed to transition to a sustainable economy remain insufficient. The financing gap for biodiversity is estimated between US$598-824 billion per year,[5] for climate change

[1] Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Washington, DC: Island Press. https://www.millenniumassessment.org/en/Synthesis.html

[2] Office of Science and Technology Policy, Office of Management and Budget, Department of Commerce. (2023). National Strategy to Develop Statistics for Environmental-Economic Decisions: A U.S. System of Natural Capital Accounting and Associated Environmental-Economic Statistics. Published by the U.S. White House. https://www.whitehouse.gov/wp-content/uploads/2023/01/Natural-Capital-Accounting-Strategy-final.pdf

[3] World Economic Forum (2020). Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy. https://www.weforum.org/reports/nature-risk-rising-why-the-crisis-engulfing-nature-matters-for-business-and-the-economy/

[4] PwC (2022). Asset and wealth management revolution 2022: Exponential expectations for ESG. https://www.pwc.com/awm-revolution-2022

[5] Deutz, A., Heal, G. M., Niu, R., Swanson, E., Townshend, T., Zhu, L., Delmar, A., Meghji, A., Sethi, S. A., and Tobinde la Puente, J. (2020). Financing Nature: Closing the global biodiversity financing gap. The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability.

about US$5 trillion per year,[6] and for the transition to a more sustainable, resilient, and equitable economy, orders of magnitude larger.[7]

Natural assets have been valued at about US$5,000 trillion[8] and nature's annual production of goods and services at US$125 trillion per year.[9] Listed NACs can convert the long-understood – but to-date unpriced – value of nature into equity capital which can generate the financial capital needed to manage, protect, and restore healthy ecosystems over the long term.

[6] Boehm, S., K. Lebling, K. Levin, H. Fekete, J. Jaeger, R. Waite, A. Nilsson, J. Thwaites, R. Wilson, A. Geiges, C. Schumer, M. Dennis, K. Ross, S. Castellanos, R. Shrestha, N. Singh, M. Weisse, L. Lazer, L. Jeffery, L. Freehafer, E. Gray, L. Zhou, M. Gidden, and M. Gavin. (2021). State of Climate Action 2021: Systems Transformations Required to Limit Global Warming to 1.5°C. Washington, DC: World Resources Institute: https://doi.org/10.46830/wrirpt.21.00048.

[7] Force for Good (2021). *Capital as a Force for Good, 2021 Report*. Chapter 2. https://www.forcegood.org/frontend/img/2021_report/pdf/Funding_the_SDGs_an d_a_Sustainable_Future.pdf#toolbar=0

[8] Based on Costanza et al (2014). Changes in the global value of ecosystem services, *Global Environmental Change*, 26, 152-158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

[9] Costanza et al (2014). Changes in the global value of ecosystem services, *Global Environmental Change*, 26, 152-158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

GLOSSARY OF KEY TERMS

Unless otherwise stated, this document utilizes the definitions of the United Nations' System of Environmental-Economic Accounting — Ecosystem Accounting ("SEEA EA").[10] In addition, there are terms unique to Natural Asset Companies, defined below:

Ecological Performance Report – A report with statistical information on the ecological performance of a NAC, including sections with data on (i) Natural Production, (ii) Natural Assets, and (iii) Underlying Asset Condition. This Report is unique to NACs and will be provided in addition to traditional financial statements.

- **Natural Production Section** – A section of the Ecological Performance Report that provides information on the annual flows of ecosystem services managed by a NAC.
- **Natural Assets Section** – A section of the Ecological Performance Report that provides information on the net present value of natural assets producing ecosystem services managed by a NAC.
- **Underlying Asset Condition Section** – A section of the Ecological Performance Report that provides biophysical information on the extent and condition of the ecosystems being managed by a NAC.

Ecological Performance Rights – The rights to the value of natural assets and the production of ecosystem services in a designated area, including the authority to manage the area. These rights are granted to a NAC, from a natural asset owner, as provided through a license or other legal instrument.

Ecosystem Service Valuation – The assignation of an economic value to an ecosystem service using one of many valuation methodologies accepted today.

IEG Ecological Performance Reporting Framework – IEG has developed a specific framework for NACs to measure, value, and report on ecosystem service values and on the condition of the natural assets being managed. In addition, this Reporting Framework defines the components and structure of the Ecological Performance Report to ensure the values are reported transparently and consistently.

Natural Asset – A statistical representation of ecosystems for accounting purposes that defines them as productive units of ecosystem services. The term "natural asset" is equivalent to SEEA EA's term "ecosystem asset." Natural assets can be monetized directly or indirectly. Like traditional assets, they have economic value and are expected to provide future streams of benefits. In the singular form, the term refers to an ecosystem type (e.g., a delineated forest).

Natural Asset Companies – Corporations that hold the rights to the ecological performance of a defined area and have the authority to manage the area for conservation, restoration, or sustainable management.

[10] United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting

Natural Production – The production and use of ecosystem goods and services by natural assets.

Technical Ecological Performance Study – The study conducted to characterize, measure, and value the ecosystems managed by a NAC. The information collected in this study is used to populate a NAC's Ecological Performance Report.

GLOSSARY OF ABBREVIATIONS & ACRONYMS

ASC – Accounting Standards Codification

EAA – Ecosystem Accounting Area

ECT Classes – Ecosystem Condition Typology Classes

EPR – Ecological Performance Report

ESV – Ecosystem Service Valuation

FASB – Financial Accounting Standards Board

GAAP – US Generally Accepted Accounting Principles

IEG – Intrinsic Exchange Group, Inc.

IFRS – International Financial Reporting Standards

NAC – Natural Asset Company

NPV – Net Present Value

Reporting Framework – IEG's Ecological Performance Reporting Framework

SAB – SEC Staff Accounting Bulletin

SEEA– United Nations' System of Environmental-Economic Accounting

SEEA EA – United Nations' System of Environmental-Economic Accounting – Ecosystem Accounting

SNA – System of National Accounts

Technical EP Study – Technical Ecological Performance Study

TEV – Total Economic Value

PURPOSE

The purpose of this document is to describe the reporting framework for how NACs are required to measure, value, and report on the ecosystem services and natural assets they manage, in a manner that is transparent, robust, and consistent. A NAC's reporting will seek to provide investors with accurate statistical information about ecosystems under the NAC's management and their ecosystem services.

NATURAL ASSET COMPANY

Natural Asset Companies are corporations that hold the rights to the value of natural assets and the ecosystem services produced by the areas they have authority to manage. These rights, termed Ecological Performance Rights, are similar to air rights or timber rights, and are granted to a NAC by the owners of the natural assets. These assets can be areas that are publicly owned, such as a national park, or tracts of privately owned property held by individuals or corporations. By charter, each NAC will have a board and management team with a mandate to maintain, protect, restore, and grow the natural assets under their management.

A NAC's business model is to actively manage the licensed area, which includes activities that generate traditional cash flows (e.g., revenues from carbon credits, crops, fisheries, ecotourism). In addition, NACs will support the generation and growth of ecosystem services that, while not currently monetized, can be valued via a market transaction and considered as part of the overall value of a NAC's equity.

VALUES REFLECTED IN A NATURAL ASSET COMPANY

Natural Asset Companies are designed to reflect the value of natural assets over time. This includes, but is not limited to, the following:

- **Commercial Production** – The use of natural resources, built assets, financial capital, and labor to produce goods and services as reported under US Generally Accepted Accounting Principles ("GAAP") or International Financial Reporting Standards ("IFRS"). This includes ecosystem services that are monetized (i.e., generating revenue) by a NAC (e.g., ecotourism, food production).

- **Production of Ecosystem Services** – The production of ecosystem services that are not monetized by a NAC (e.g., pollination or flood risk reduction), which will be captured within a NAC's ecological performance reporting.

- **Nature's Non-Use Value** – The less tangible inherent value of nature, including people's value for species and ecosystems in and of themselves. This category includes:

    - **Bequest Value** – The value of preserving nature for future generations.
    - **Existence Value** – The value people place to ensure the continued existence of ecosystems and/or the species that live within them.
- **Option Value** – The value of having the option to use or access a natural resource or ecosystem service now, and in the future. This includes the value for ecosystem services not yet identified or quantified.

Once a NAC's equity is traded and/or an ecosystem service is commercialized in a market, these additional values and characteristics, among others, may also be realized:

- **Store of Value** – A NAC's equity is a store of value like any other security or asset, and includes the stocks of water, timber, biodiversity, soil, carbon, fish, and other natural assets that make life on Earth possible.
- **Quantity and Quality of Ecosystem Services** – The NAC structure creates an incentive and an enabling environment to focus on increasing both the quantity and quality of ecosystem services produced. Innovation, acquisitions, and growing demand for ecosystem services may all play a role in this dynamic.
- **Risk Mitigation** – By recognizing positive and negative externalities and a broad spectrum of ecosystem services, nature-based risks may be revealed, mitigated, and, in some cases, converted into an asset/income stream. Additionally, financial, operational, litigation, and reputational risks may be managed through any resulting improvements in land management practices.
- **Uncorrelated Asset** – The production of ecosystem services is not dependent on systemic economic or business cycles.
- **Increased Competitiveness** – As policy and regulatory environments evolve to manage climate change, biodiversity loss, and other natural resource pressures, NACs may be able to demonstrate the value of nature-positive impacts and capitalize on developing new markets that may emerge for ecosystem services.

A NAC will report on the Total Economic Value ("TEV") of the ecosystems managed within its boundaries through the biophysical and economic information it compiles. The concept of TEV illustrates the different types of economic values that can be assigned to natural assets (see **Figure 1**). It is defined as the "use" and "non-use" values associated with people's interactions with nature and reflects the different types of economic impacts that ecosystems have on human well-being. More specifically, **direct use values** refer to goods or services that can be used or consumed directly by individuals, such as food or ecotourism. **Indirect use values** refer to the work that nature does to maintain ecosystem functioning that is indirectly beneficial to people or that is indirectly used by people (e.g., coastal protection). **Non-use values** are values assigned to ecosystems, irrespective of whether people use or intend to use the ecosystems. There are two main types of non-use values, including the value of ensuring the ecosystems are available to future generations (**bequest value**) or the value of protecting the continued existence of an ecosystem, including the value of having a functioning ecosystem for the sake of its own integrity (**existence value**).[11]

A third type of value refers to having the option to use or access a natural resource or ecosystem service now, and in the future (**option value**), even if its use is never realized or the benefit it provides is currently unknown. Option values are classified as "use values" from an accounting perspective in SEEA EA but are often presented separately in other frameworks.[12] For purposes of transparency, option values are conceptualized as separate categories of values for NACs.

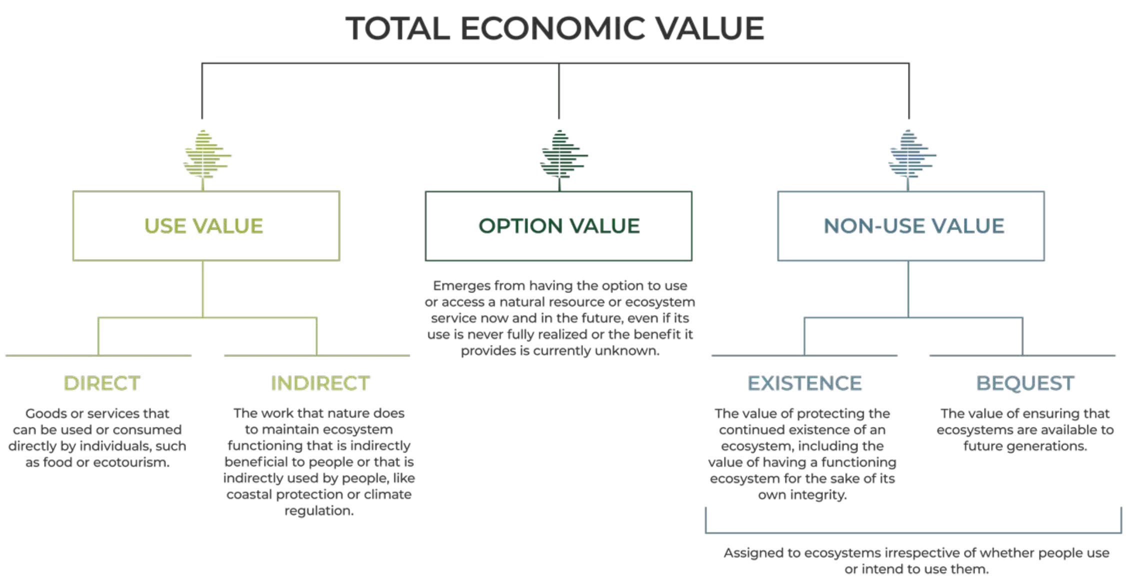

Figure 1: The Total Economic Value Framework for Valuation of Ecosystems

NATURAL ASSET COMPANY REPORTING APPROACH

In recent years, there have been significant advancements in the natural capital accounting field to better incorporate and report on the economic value of nature, often referred to as the value of natural capital. In 2019, an international standard for the "Monetary Valuation of Environmental Impacts and Related Environmental Aspects" (ISO 14008) was released with the objective of increasing awareness, comparability,

[11] United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting.

[12] Grant, Susie & Hill, Simeon & Trathan, Philip & Murphy, Eugene. (2013). Ecosystem services of the Southern Ocean: Trade-offs in decision-making. Antarctic science / Blackwell Scientific Publications. 25. 603-617. 10.1017/S0954102013000308.

and transparency in the monetary valuation of environmental costs and benefits. In 2021, a British Standard entitled "Natural Capital Accounting for Organizations – Specification" (BS 8632) was released with the objective of providing guidance to better integrate natural capital considerations into financial and other business analyses.[13] In 2021, the United Nations Statistical Commission released an international statistical standard describing an accounting framework to measure, report, and value ecosystem services and natural assets entitled the System of Environmental-Economic Accounting – Ecosystem Accounting ("SEEA EA"). SEEA EA provides the most comprehensive guidance on natural capital accounting and is of particular relevance to the valuation of NACs due to its spatial approach and its focus on measuring and reporting on the ecosystem services produced by ecosystems.

In this context, IEG adopted SEEA EA as the accounting standard for the measurement and valuation of natural assets and ecosystem services, with some minor adaptations to ensure that the valuations of NACs provide comprehensive, understandable, consistent, robust, and transparent information to investors and other users of the companies' ecological performance reporting materials. In particular, IEG's Ecological Performance Reporting Framework ("Reporting Framework") aims to report the TEV of natural assets, which is in line with the recommendations of the British Standard for natural capital accounting (BS 8632) for financial organizations and the ISO Standard 14008.

The use of SEEA EA standards to report specifically on the value of a NAC is described in this document (Exhibit 3), which describes IEG's Reporting Framework. This Reporting Framework includes specifications on how to apply SEEA EA to report on the annual performance of NACs. Given that NACs are designed to manage and grow the value of natural assets and the production of ecosystem services, a NAC's activities are not completely captured by traditional financial reporting standards like GAAP/IFRS as most ecosystem services are not monetized today (i.e., they are not traded in markets or generating revenue). To reflect the value of the non-monetized ecosystem services and measure management's performance, NYSE will require an Ecological Performance Report ("EPR"), which will be produced annually. This report will be populated with the results obtained from a Technical Ecological Performance Study ("Technical EP Study"). The Reporting Framework defines:

1. the steps to characterize, measure, and value the NAC's ecosystem services and natural assets in a Technical EP Study, and

2. the components and structure of the EPR including guidance to compile its sections, to ensure transparency, robustness, and consistency in the reporting of statistical information about the natural assets.

While the data in the EPR is not GAAP/IFRS accounting data, the preparation and review of the EPR will rely on certain key concepts and standards followed in US GAAP reporting, with the objective of providing consistent, transparent, and reliable information to investors. More specifically, the concept of materiality will be defined per

[13] This standard is currently seeking an ISO status (ISO/NP 14054).

the US securities law definition.[14] Guidance regarding the application of materiality to address corrections of material errors in the EPR will follow the SEC's Staff Accounting Bulletins ("SABs") 99 and 108. In addition, the presentation of disclosures pertaining to the EPR will follow the principles that make up the guidance from the FASB's Accounting Standards Codification ("ASC") 820 pertaining to fair value measurement and disclosures and ASC 250 for accounting changes and error corrections.

USE OF THE SEEA EA STANDARD

SEEA EA brings together decades of research and contributions from world experts to create an international standard for natural capital accounting. Over 90 countries have implemented SEEA to measure and track their natural assets, including the United States who in 2023 officially announced its national strategy to create natural capital accounting statistics, citing standards from SEEA EA. SEEA EA provides a consistent set of definitions, concepts, and approaches to measure the extent of ecosystem assets, their condition, and the biophysical flow of ecosystem services. It also provides recommendations for measuring economic values associated with these ecosystem services, consistent with the System of National Accounts ("SNA"), and to estimate asset values using a net present value approach. In 2022, SEEA EA also released a supplemental report with more detailed recommendations for the valuation of ecosystem services for the purpose of natural capital accounting.[15]

The objective for NACs is to provide transparent information on the TEV of natural assets, including both private benefits to individuals and collective benefits to the public at large. While SEEA EA provides a framework that is compatible with reporting TEV and guidance to value the TEV of natural assets, it is important to note that SEEA EA applies accounting principles from the SNA and is broadly intended to underpin the compilation of national statistics. These principles and core objective of SEEA EA result in guidance for the valuation component of natural capital accounting that focuses on reporting exchange values and use values of ecosystems. These values reflect metrics that are comparable to market prices, but they exclude important value dimensions that are critical to ecosystem functioning. Information on these added value dimensions, the non-use values of nature and the consumer surplus that ecosystems provide, can also be provided in a NAC's reporting materials, following the guidance provided by SEEA EA for supplemental value information which involves presenting them transparently and in a disaggregated way. This allowance marks a difference in scope from SEEA EA but maintains an approach for NAC's that is in line with SEEA EA recommendations and those from other natural capital valuation standards (such as the BS 8632 and ISO 14008).

[14] U.S. Securities and Exchange Commission. (2022). Statement on Assessing Materiality: Focusing on the Reasonable Investor When Evaluating Errors. Available at: https://www.sec.gov/news/statement/munter-statement-assessing-materiality-030922#_edn4

[15] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York.

The Reporting Framework uses a combination of SEEA EA and accepted accounting principles to:

1. appraise the TEV of the natural assets managed by a NAC,
2. quantify the positive externalities from conservation and restoration,
3. build on SEEA EA to value a comprehensive suite of ecosystem services and their TEV,
4. provide a reporting framework that provides additional information to GAAP/IFRS financial statements, with the additional statistical information provided in an annual EPR, and
5. link the value of nature to a financial instrument (NAC equities) and market mechanism (through the listing of NACs on the NYSE) to enable the conversion of natural asset value to financial capital.

MEASURING, VALUING & REPORTING ECOLOGICAL PERFORMANCE IN A NAC

The approaches for measuring, characterizing, and valuing the natural assets managed by a NAC are based on the SEEA EA standards.[16] With the objective of reporting information on the TEV of the natural assets managed by a NAC, SEEA EA is used as a standard to maintain consistency in concepts, approaches, and in the organization of information to report TEV measures.

The sections outlined below represent the required steps and approach for characterizing and valuing the natural assets managed by a NAC. These sections correspond to the different sets of accounts described within SEEA EA, including information on the extent and condition of the assets as well as the biophysical production of ecosystem services and their corresponding economic value in monetary terms. This information will be produced every year (in line with a NAC's accounting period) and will be reported in each NAC's EPR, which includes sections with data on (i) Natural Production, (ii) Natural Assets, and (iii) Underlying Asset Condition. Details on the methods employed, data sources used, calculations, and other aspects of the study will be documented in a Technical EP Study that will be used to populate the EPR.

The initial (Year 0) EPR is of particular importance because it will establish the baseline for the applicable NAC and set the scope for what the NAC will include in its EPR, by specifying the ecosystem services included and general approach to be taken for their valuation. This initial assessment and study will set the expectations for future reporting, given that consistency in measurement and methods is required to be able to accurately interpret ecological performance over time. A change in valuation method, data sources, or assumptions may be deemed appropriate in subsequent years, if new markets develop, new data or information becomes available, previous information is

[16] United Nations et al. (2021). *System of Environmental-Economic Accounting*— Ecosystem *Accounting (SEEA EA).* White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting.

no longer available or relevant, valuation techniques improve, or if market conditions change. If a change of this nature happens, it must be clearly explained and justified in the Technical EP Study, and if deemed necessary, presented in relevant disclosures. Once the baseline is established at Year 0, subsequent analyses (and EPR reporting) will have to use the most current data available and aim to report on the extent, condition, production, and TEV generated in the accounting year to which the EPR corresponds.

Overall, the concept of materiality must be assessed following the US securities law definition.[17] Guidance regarding the application of materiality to address corrections of material errors in the EPR must follow the SEC's Staff Accounting Bulletins ("SABs") 99 and 108. In addition, the presentation of disclosures pertaining to the EPR must follow the principles that make up the guidance from the FASB's Accounting Standards Codification ("ASC") 820 pertaining to fair value measurement and disclosures and ASC 250 for accounting changes and error corrections.

It is important that experts with knowledge of the subject matter (i.e., natural capital accounting, ecosystem service valuation, relevant ecological disciplines, and local ecosystems) are involved in the creation of the EPR. They should refer to SEEA EA to structure the analyses and follow definitions in accordance,[18] while following the specific requirements and outputs needed for NACs as described in this document. In addition, the decision-making process and methods adopted to populate the EPR should be guided by the principles of relevance, transparency, accuracy, a focus on material information, consistency, and comparability.

The information produced should lend itself to meaningful reporting on an annual basis (i.e., to report annual changes). The outputs described in each step below should be presented under clearly labeled headings in the Technical EP Study. These will then be used to populate the EPR.

Step 1. Define a NAC's Ecosystem Accounting Area

The first step to compile information for a NAC is to define the spatial boundary of the NAC and its total extent. As stated in SEEA EA, an ecosystem accounting area ("EAA") is the geographical territory for which an ecosystem account is compiled. The EAA will represent the area under the NAC's management that is used to derive and report ecosystem service values. This step requires identifying clearly defined geographical boundaries for the NAC, based on what it has the legal authority to manage in accordance with its charter. Chapter 3 of SEEA EA provides definitions and guidance on how to establish the EAA for accounting purposes. This guidance should be followed when setting up the geographical boundaries of the area managed by a NAC. If areas within the geographic area managed by a NAC are excluded from the ecosystem service valuation (i.e., from the EAA) due to limitations in the license agreement (where applicable) or other legal or contractual limitations, the areas excluded and the reason

[17] U.S. Securities and Exchange Commission. (2022). Statement on Assessing Materiality: Focusing on the Reasonable Investor When Evaluating Errors. Available at: https://www.sec.gov/news/statement/munter-statement-assessing-materiality-030922#_edn4

[18] United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting.

for exclusion must be clearly and transparently noted. Note that a NAC can include multiple ecosystem types, land uses, and multiple sites. The resolution of the data and method used to establish the boundary of the NAC should be stated, as well as any potential sources of error in the estimation of the extent of area within the boundary.

OUTPUTS:

- Map of the area that will make up the NAC and its total spatial extent in hectares or acres.
- If relevant, a table with areas managed by the NAC but excluded from the EAA, including the reason for their exclusion.
- A write-up detailing the methods used to establish the NAC and the EAA boundary.

Step 2. Determine Ecosystem Extent

The spatial boundaries of a NAC will cover one or more distinct ecosystems. In this step, the entire EAA is allocated to discrete ecosystem types, each of which is treated as a distinct spatial unit for accounting purposes. The essence of the ecosystem accounting structure under SEEA EA is the representation of the biophysical environment in terms of distinct spatial areas, each representing an ecosystem type. What SEEA EA defines as ecosystem assets are equivalent to IEG's concept of "natural assets." These are the statistical units for accounting. Therefore, to compile information in an organized manner and track a NAC's performance in the future, the entire EAA of a NAC must be allocated to a mutually exclusive ecosystem type that will correspond to distinct natural assets. The classification of ecosystem types must be comprehensive and must be mapped to the IUCN Global Ecosystem Typology (GET) Level 3, Ecosystem Functional Group.[19]

Chapter 3 and Chapter 4 of SEEA EA provide extensive guidance on how to delineate and allocate the EAA of a NAC to discrete and mutually exclusive ecosystem types. These sections should be closely followed and used to estimate the extent of the ecosystem types managed by the NAC and the nature of ecosystem extent changes year to year.

In addition, the information compiled must reflect current conditions (using the most recent data) with the intention of giving a snapshot of the ecosystems present in the current accounting period (the most recent year that corresponds to the audited financial statements). If a change in the extent of an ecosystem type is reported, the nature of the change must be noted. Also, given the need for accuracy in a NAC's reporting, there must be an effort to use high resolution data. As noted in SEEA's guidance on biophysical modeling,[20] a tiered approach to spatial resolution can be

[19] Keith, D.A., Ferrer-Paris, J.R., Nicholson, E. and Kingsford, R.T. (eds.) (2020). *The IUCN Global Ecosystem Typology 2.0: Descriptive profiles for biomes and ecosystem functional groups*. Gland, Switzerland: IUCN.

[20] Guidelines on Biophysical Modelling for Ecosystem Accounting – version 2.0 (United Nations 2021).

adopted, and a resolution of at least 1km will be required. With better resolution, there will be more certainty in the results presented and ultimately by the third year of operation there should be a geographical resolution of 1 to 10 meters.

The process of identifying ecosystem types and mapping GIS data to ecosystem types must be clearly stated, including the resolution of the data and the definitions for each ecosystem type. The extent of each ecosystem type must be clearly presented. If developed lands (i.e., non-natural areas), such as roads or residential areas, are included in the NAC's overall boundaries, their corresponding extent should also be provided, even if they are not valued for their ecosystem service production.

OUTPUTS:

- An ecosystem extent table (in hectares or acres) for the ecosystems that will be valued as natural assets managed by the NAC and changes in extent relative to previous periods.
- A description of the methods used to determine the extent of each ecosystem type and notes on the nature of any extent changes, relative to the previous accounting period.
- Definition of each ecosystem type found within the geographic area covered by the NAC and within the EAA, mapped to the IUCN GET, Level 3, Ecosystem Functional Group.

Step 3. Determine Ecosystem Condition

Once ecosystem types are identified, the next step will be to assess, measure and record their condition. As noted in SEEA EA, ecosystem condition is defined as "the quality of an ecosystem measured in terms of its abiotic and biotic characteristics," with the aim of measuring and reporting on ecosystem integrity. With this aim, condition is assessed with respect to an ecosystem's composition, structure, and function. Condition measures will often indicate the ecosystem's capacity to supply ecosystem services in the future, which is important information to obtain a more complete accounting picture of the natural assets being evaluated.

Chapter 5 of SEEA EA describes a three staged approach to measuring ecosystem condition that NACs must follow. First, measurement variables are determined based on ecosystem characteristics and corresponding appropriate descriptors of ecological integrity. The use of ecosystem variables as the measurement unit comprises "stage one" reporting. As data and methods are refined, ecosystem condition indicators are derived in "stage two" reporting. This step requires the contextualization of the measurement variables against reference levels in order to benchmark the values obtained. Eventually composite indices are established to synthesize and help interpret the reported ecological condition information. The use of aggregating indices makes up "stage three" reporting. Ultimately, by the third annual reporting period of a NAC, the reporting of composite indices for the multiple ecosystem types managed by such NAC will be required. These indices must synthesize the condition data, with the objective of presenting aggregated information at the highest level possible (i.e., the ecosystem type or the NAC as a whole). This requirement may be developed in a phased approach during the initial years, allowing time for data collection and analyses to be established and streamlined.

The selection of ecosystem variables must be guided by the ecological integrity principles described in SEEA EA. Generally, variables that reflect a role in ecological processes and contribute to whole-ecosystem functioning and their risk of change should be prioritized. Examples of potential ecosystem variables to consider are provided in Table 5.7 in SEEA EA.

Regarding the number of ecosystem condition metrics (i.e., indicators or variables) required for a NAC, at least one condition variable for each of the six ecosystem condition typology ("ECT") classes described in SEEA EA will be required for each ecosystem type managed by the NAC. The full suite of condition variables that will characterize a NAC may be incorporated in a phased approach over the NAC's first three annual reporting periods. If a given ecosystem type is deemed to have no material impact to representing the overall condition of a NAC, that ecosystem type may be excluded (i.e., have no specific condition variable/indicator for that ecosystem type), with an ecological judgement explaining its exclusion. The selected indicators for each ecosystem type must be based on the principles of materiality of the information presented, relevance to a NAC, ability to consistently present information on an annual basis, and the ability to have a reasonable level of accuracy. The objective of this component of the Reporting Framework is to represent the overall ecological integrity of the natural assets managed by a NAC.

Ecosystem condition variables, indicators, and/or indices should represent the conditions of the current accounting period. Changes from the previous accounting period will also be noted. The nature of these changes, including the driving factors for these changes, must be clearly recorded and described in the Technical EP Study and the Underlying Asset Condition section of the EPR.

In addition, to promote comparability between NACs, the use of biodiversity related metrics (e.g., species abundance and richness) to represent ecosystem condition is recommended. These metrics should be established following the guidance of Chapter 5 of SEEA EA. In addition, the basis for selection of the species included in richness and abundance counts must be transparently presented. Species to include must be determined through a scientific assessment of contributions to ecosystem integrity and through local expert opinion.

The initial (Year 0) metrics may need to rely on existing authoritative data sources (e.g., IUCN's Red List of Threatened Species, Living Planet Index), while longitudinal or sufficient primary data is collected. Where field measurement is possible, it must follow appropriate sampling methods and robust statistical models to ensure accuracy in the indicators presented. If secondary, authoritative data sources are used, these should be validated and an analysis of potential error should be included. Data quality assurance processes must be carried out checking for accuracy, completeness, reliability, relevance, and timeliness.

Methods and data sources should be streamlined to ensure accuracy, consistency, comparability, transparency, and replicability on an annual basis. Data gaps and underlying assumptions must be clearly outlined in the method description and an error and uncertainty analysis should be carried out to help users of this information interpret the certainty of the results. If data gaps exist, preventing the measurement of key indicators or species, those may be proposed for inclusion in subsequent years.

OUTPUTS:

- Ecosystem condition variables, indicators, and reference levels for the ecosystems that will be treated as natural assets within the NAC.
- An ecosystem condition index (or series of indices at the highest possible level of aggregation) for the NAC.
- A description of the approach and methods used to select and measure the chosen ecosystem condition variables, indicators, as well as weights and aggregation methods for the development of the indices.
- A description of any observed changes in condition relative to the previous accounting period, and the nature of these changes.

Step 4. Identify Ecosystem Services and Conduct a Preliminary Assessment of Their Relative Value

The step of identifying ecosystem services will involve a site-based assessment and consultation with local stakeholders and subject matter experts. This step will also include an initial review of the information available to determine the ecosystem services that are present, those that can be valued based on data availability, and those that should be included based on their relevance and materiality for the NAC. Section 6 of SEEA EA provides guidance on how to select ecosystem services, including guidance to avoid double-counting and ensure relevance to the valuation process, both of which are important requirements for a NAC's EPR.

To maintain consistency and comparability between ecosystem types and among NACs, a list and definitions of ecosystem services adapted from SEEA EA[21] must be used to derive the set of ecosystem services to be quantified and valued in a NAC. This list includes 38 general categories outlined in **Table 1**.

[21] United Nations et al. (2021). *System of Environmental-Economic Accounting Ecosystem Accounting (SEEA EA)*. White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting, Table 6.3, pg. 131.

Table 1. List of Ecosystem Service Categories[22]

	ECOSYSTEM SERVICE	DESCRIPTION
	PROVISIONING SERVICES	
1	**CROP PROVISIONING SERVICES**	The ecosystem's contributions to the growth of cultivated plants that are harvested for various uses including food and fiber production, fodder, and energy.
2	**GRAZED BIOMASS PROVISIONING SERVICES**	The ecosystem's contributions to the growth of grazed biomass, that is an input to the growth of cultivated livestock. This service excludes the ecosystem contributions to the growth of crops used to produce fodder for livestock (e.g., hay, soybean meal) as these contributions are included under crop provisioning services.
3	**LIVESTOCK PROVISIONING SERVICES**	The ecosystem's contributions to the growth of cultivated livestock and livestock products (e.g., meat, milk, eggs, wool, leather), that are used for various uses, primarily food production.
4	**AQUACULTURE PROVISIONING SERVICES**	The ecosystem's contributions to the growth of animals and plants (e.g., fish, shellfish, seaweed) in aquaculture facilities that are harvested by economic units for various uses.
5	**WOOD PROVISIONING SERVICES**	The ecosystem's contributions to the growth of trees and other woody biomass in both cultivated (plantation) and uncultivated production contexts that are harvested for various uses including timber production and energy. This service excludes contributions to non-wood forest products.
6	**WILD FISH AND OTHER NATURAL AQUATIC PRODUCTS**	The ecosystem's contributions to the growth of fish and other aquatic biomass that are captured in uncultivated production contexts by economic units for various uses, primarily food production.
7	**WILD ANIMALS, PLANTS AND OTHER BIOMASS**	The ecosystem's contributions to the growth of wild animals, plants, and other biomass that are captured and harvested in uncultivated production contexts for various uses. The scope includes non-wood forest products ("NWFP") and

[22] This list is based on SEEA EA's list of ecosystem services and, as noted by SEEA EA, is not exhaustive.

		services related to hunting, trapping, and bio-prospecting activities; but excludes wild fish and other natural aquatic biomass (included in previous class).
8	**GENETIC MATERIAL SERVICES**	The ecosystem's contributions from all biota (including seed, spore, or gamete production) that are used by economic units, for example (i) to develop new animal and plant breeds; (ii) in gene synthesis; or (iii) in product development directly using genetic material.
9	**WATER SUPPLY**	Water supply services reflect the combined ecosystem contributions of water flow regulation, water purification, and other ecosystem services to the supply of water of appropriate quality to users for various uses including household consumption.
10	**ORNAMENTAL RESOURCES**	The ecosystem's contribution to the provisioning of resources for clothing, jewelry, handicraft, worship, and decoration.
11	**MEDICINAL RESOURCES**	The ecosystem's contribution to the provisioning of traditional medicines, pharmaceuticals, and assay organisms.
	REGULATING AND MAINTENANCE SERVICES	
12	**GLOBAL CLIMATE REGULATION SERVICES**	The ecosystem's contributions to the regulation of the chemical composition of the atmosphere and oceans that affect global climate through the accumulation and retention of carbon and other GHG (e.g., methane) in ecosystems and the ability of ecosystems to remove (sequester) carbon from the atmosphere and retain (store) carbon in ecosystems. Carbon storage and sequestration should be reported separately, clearly indicating the time horizon over which they are measured.
13	**RAINFALL PATTERN REGULATION SERVICES (AT SUB-CONTINENTAL SCALE)**	The ecosystem contributions of vegetation, in particular forests, in maintaining rainfall patterns through evapotranspiration at the sub-continental scale. Forests and other vegetation recycle moisture back to the atmosphere where it is available for the generation of rainfall. Rainfall in interior parts of continents fully depends upon this recycling.

14	**LOCAL (MICRO AND MESO) CLIMATE REGULATION SERVICES**	The ecosystem's contributions to the regulation of ambient atmospheric conditions (including micro and mesoscale climates) through the presence of vegetation that improves the living conditions for people and supports economic production. Examples include the evaporative cooling provided by urban trees ('green space'), the role of urban water bodies ('blue space') and the contribution of trees in providing shade for humans and livestock.
5	**AIR FILTRATION SERVICES**	The ecosystem's contributions to the filtering of airborne pollutants through the deposition, uptake, fixing, and storage of pollutants by ecosystem components, particularly plants, that mitigates the harmful effects of the pollutants.
16	**SOIL QUALITY REGULATION SERVICES**	The ecosystem's contributions to the decomposition of organic and inorganic materials and to the fertility and characteristics of soils (e.g., for input to biomass production).
17	**SOIL EROSION CONTROL SERVICES**	Soil erosion control services are the ecosystem contributions, particularly the stabilizing effects of vegetation, that reduce the loss of soil (and sediment) and support use of the environment (e.g., agricultural activity, water supply).
18	**LANDSLIDE MITIGATION**	Landslide mitigation services are the ecosystem contributions, particularly the stabilizing effects of vegetation, that mitigate or prevent potential damage to human health and safety and damaging effects to buildings and infrastructure that arise from the mass movement (wasting) of soil, rock, and snow.
19	**SOLID WASTE REMEDIATION**	Solid waste remediation services are the ecosystem contributions to the transformation of organic or inorganic substances, through the action of microorganisms, algae, plants, and animals that mitigates their harmful effects.
20	**WATER PURIFICATION SERVICES (WATER QUALITY AMELIORATION)**	Water purification services are the ecosystem contributions to the restoration and maintenance of the chemical condition of surface water and groundwater bodies through the breakdown or removal of nutrients and other pollutants by ecosystem components that mitigate the harmful effects of the pollutants on human use or health.

21	**BASELINE WATER FLOW MAINTENANCE SERVICES**	Water regulation services are the ecosystem contributions to the regulation of river flows and groundwater and lake water tables. They are derived from the ability of ecosystems to absorb and store water, and gradually release water during dry seasons or periods through evapotranspiration and hence secure a regular flow of water.
22	**PEAK WATER FLOW MITIGATION SERVICES**	Water regulation services are the ecosystem contributions to the regulation of river flows and groundwater and lake water tables. They are derived from the ability of ecosystems to absorb and store water, and hence mitigate the effects of flood and other extreme water-related events. Peak flow mitigation services will be supplied together with river flood mitigation services in providing the benefit of flood protection.
23	**COASTAL PROTECTION SERVICES**	Coastal protection services are the ecosystem contributions of linear elements in the seascape, for instance coral reefs, sandbanks, dunes, or mangrove ecosystems along the shore, in protecting the shore and thus mitigating the impacts of tidal surges or storms on local communities.
24	**RIVER FLOOD MITIGATION SERVICES**	River flood mitigation services are the ecosystem contributions of riparian vegetation which provides structure and a physical barrier to high water levels and thus mitigates the impacts of floods on local communities. River flood mitigation services will be supplied together with peak flow mitigation services in providing the benefit of flood protection.
25	**STORM MITIGATION SERVICES**	Storm mitigation services are the ecosystem contributions of vegetation including linear elements, in mitigating the impacts of wind, sand and other storms (other than water related events) on local communities.
26	**NOISE ATTENUATION SERVICES**	Noise attenuation services are the ecosystem contributions to the reduction in the impact of noise on people that mitigates its harmful or stressful effects.
27	**POLLINATION SERVICES**	Pollination services are the ecosystem contributions by wild pollinators to the fertilization of crops that maintains or increases

		the abundance and/or diversity of other species that economic units use or enjoy.
28	**SEED DISPERSAL SERVICES**	The ecosystem's contribution by seed dispersal species that maintains or increases the abundance and/or diversity of plant species that economic units use or enjoy.
29	**PEST CONTROL SERVICES**	Biological control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of pests on biomass production processes or other economic and human activity.
30	**DISEASE CONTROL SERVICES**	Disease control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of species on human health.
31	**NURSERY POPULATION MAINTENANCE SERVICES**	The ecosystem contributions necessary for sustaining populations of species that economic units ultimately use or enjoy either through the maintenance of habitats (e.g., for nurseries or migration) or the protection of natural gene pools.
32	**SOIL FORMATION SERVICES**	The ecosystem's contribution to the creation of soils for agricultural and ecosystems structural integrity.
33	**HABITAT MAINTENANCE SERVICES**	The ecosystem's contribution to the formation and maintenance of living spaces for plants or animals and other organisms, providing them with shelter and protection.
	CULTURAL SERVICES	
34	**RECREATION-RELATED SERVICES**	The ecosystem contributions through the biophysical characteristics and qualities of ecosystems that enable people to use and enjoy the environment through direct, in-situ, physical, and experiential interactions with the environment. This includes services to both locals and non-locals (i.e., visitors, including tourists). Recreation-related services may also be supplied to those undertaking recreational fishing and hunting.
35	**VISUAL AMENITY SERVICES**	The ecosystem contributions to local living conditions through the biophysical characteristics and qualities of ecosystems that provide sensory

		benefits, especially visual. This service is often valued through the added value to real estate property and/or combines with other ecosystem services, including recreation-related services and noise attenuation services to underpin amenity values.
36	**EDUCATION, SCIENTIFIC, AND RESEARCH SERVICES**	The ecosystem contributions through the biophysical characteristics and qualities of ecosystems, that enable people to use the environment through intellectual interactions with the environment.
37	**SPIRITUAL, ARTISTIC, AND SYMBOLIC SERVICES**	The ecosystem contributions through the biophysical characteristics and qualities of ecosystems, that are recognized by people for their cultural, historical, aesthetic, sacred or religious significance. These services may underpin people's cultural identity and may inspire people to express themselves through various artistic media.
	FLOW OF NON-USE VALUES	
38	**ECOSYSTEM AND SPECIES APPRECIATION/ EXISTENCE/BEQUEST**	Ecosystem and species appreciation concerns the well-being that people derive from the existence and preservation of the environment for current and future generations, irrespective of any direct or indirect use.

Although all ecosystem services being supplied by the NAC should be identified and an effort should be made to value all the ecosystem services identified, there may be cases where some ecosystem services are not included. This may be because they are not known, measurable, or do not have enough data available to conduct a meaningful valuation. Similarly, there may be cases where particular ecosystem services are deemed irrelevant or immaterial to the NAC. It is also possible that the NAC's license agreement may be limited with respect to some ecosystem services, in which case these limitations must be transparently disclosed.

Ultimately, a NAC must include at least six different ecosystem services categories of the 38, and it must include multiple (more than one) regulating services. The set of ecosystem services included should be diverse and represent benefits of economic importance and of local relevance. A NAC's valuation will not include ecosystem disservices or negative externalities, given the adopted definitions of ecosystem services from SEEA EA.

A NAC may include additional types of economic values associated with the ecosystems under its management, beyond the core requirements of SEEA EA. Namely, with the aim of providing relevant, material, and transparent information to investors about a NAC, a NAC may also include consumer surplus values as well as option and/or non-use values, to the extent that these represent investor interests and concerns. Therefore, these additional values can be included if they are deemed suitable based on their relevance to the NAC and the materiality of the information for the EPR. These value types are defined in SEEA EA and, if included, they should be presented as discrete valuations following the guidance of SEEA EA (Section 12.2.2), clearly labelling the type of value they represent in the NAC's reporting materials.

Extensive guidance is provided in SEEA EA, Section 6, on how to treat and analyze the various ecosystem services outlined in **Table 1**. In addition to following SEEA EA guidance, a NAC is required to conduct a preliminary desktop assessment of the ecosystem services commonly produced by the ecosystems under its management to determine which ecosystem services to include. A desktop assessment entails the use of existing data to identify the types of ecosystem services that could be produced by the ecosystems present, the expected amount that could be produced, and their relative value. A benefit transfer exercise can be used for this task to determine what ecosystem services may be present in the area and the economic values that other studies have assigned to these ecosystem services. Alternatively, or in addition, basic configurations for tools such as INVEST[23] and/or ARIES[24] can be used to determine which ecosystem services may be present and their relative importance.[25]

The desktop assessment must be complemented with an on-the-ground, site-based assessment to validate the identified ecosystem services as current and locally relevant. This assessment will be conducted through a combination of field observations, interviews, surveys, and/or focus groups with local stakeholders and experts knowledgeable of the study area. Expert opinion and judgement as well as local community consultation will be critical to identify ecosystem services produced in the NAC. What is considered most important will vary depending on the stakeholder group providing input, and as many viewpoints as possible should be included to inform the identification process. All of these assessments will guide the prioritization process for identifying ecosystem services for inclusion in the NAC. These preliminary assessments are particularly important for the initial valuation when ecosystem services present may be unknown and when data gaps may limit the ability to value all the ecosystem services identified.

The logic chains presented in Table 6.2 of SEEA EA should be used to scope the ecosystem services selected for inclusion. These logic chains will serve to guide the study of ecosystem services, their connection to the landscape, the beneficiaries of the services, among other information to be considered in the measurement and valuation.

[23] Natural Capital Project. (2022). *Natural Capital Project, 2022. InVEST 3.13.0.post5+ug.gce76c6e User's Guide. Stanford University, University of Minnesota, Chinese Academy of Sciences, The Nature Conservancy, World Wildlife Fund, and Stockholm Resilience Centre.*

[24] Villa, F., K.J. Bagstad, B. Voigt, G.W. Johnson, R. Portela, M. Honzak, and D. Batker. (2014). A methodology for adaptable and robust ecosystem services assessment. *PLoS ONE* 9(3):e91001. ARIES FOR SEEA Available at https://aries.integratedmodelling.org/aries-for-seea-user-guide/

[25] A list of selected ecosystem service modeling tools can be found in: United Nations (2022). *Guidelines on Biophysical Modelling for Ecosystem Accounting*. United Nations Department of Economic and Social Affairs, Statistics Division, New York. Available at: https://seea.un.org/content/supplemental-materials-and- tables-guidelines-biophysical-modelling#Table%204

If identified ecosystem services cannot be valued with primary valuation methods due to data gaps, time constraints, or analytical capacity, an expert-informed estimate, combined with a rigorous desktop analysis may be proposed to conduct the ecosystem service quantification and valuation. This can include a more rigorous benefit transfer valuation that can be used to estimate conservative values while better, primary data is gathered (in subsequent years). Given that desktop analyses may result in more error and uncertainty, conservative values should be prioritized when adopting this approach. If a valuation is still not possible, the justification for their exclusion should be clearly stated and the ecosystem service should still be listed as present but not valued. This includes limitations due to license agreement constraints or due to risks of double counting with information captured in the company's GAAP/IFRS financial statements. Ultimately, the inventory of ecosystem services included in the NAC must be clearly presented, noting the ecosystem services identified as existent (present during the accounting period) and the subset of ecosystem services that are quantified, measured, and valued (in the current accounting period) in the NAC's EPR.

After the initial (Year 0) ecosystem service valuations are conducted, to ensure consistency, subsequent valuations should include the list of ecosystem services valued in the previous years. The process of identification of ecosystem services will then start by validating their relative values and continued importance and existence. If additional ecosystem services are identified (i.e., they were previously unknown or not legally available for inclusion at the time of the initial valuation) and these are deemed material and suitable for inclusion in the EPR of the NAC, these must be added to the list of ecosystem services for valuation that year. Ecosystem services identified in a prior accounting period and not included for disclosed reasons may be included prospectively, provided the reasons for their inclusion are justified.

OUTPUTS:

- List of ecosystem services identified as present in the NAC.
- An initial gap assessment that identifies ecosystem services that cannot be measured, included, and/or valued for the current year, including the reason for their exclusion.
- Subset of ecosystem services prioritized for valuation.
- Subset of ecosystem services where a desktop-based study can be used to estimate an approximate economic value, in the absence of primary data.
- Expected value ranges or relative importance based on a desktop assessment and consultation with local stakeholders and experts, used to guide the ecosystem service analysis and valuation.

Step 5. Measure Ecosystem Service Flows in Biophysical Units

Once both the ecosystems and ecosystem services produced have been identified and determined to be within the scope of the NAC's license agreement and the EAA, a study will be conducted to quantify the biophysical flows of ecosystem services produced using measurable units relevant to each ecosystem service (e.g., amount of carbon sequestered and stored, tons of biomass produced, or rate of pollination). Chapters 6 and 7 of SEEA EA provide extensive guidance on how to conceptualize and measure ecosystem service flows. This guidance must be followed when compiling the outputs required for a NAC.

For ecosystem services, measurement requires a biophysical analysis of the production and flow of ecosystem services. A combination of existing data for the region, direct measurement, indirect measurements, and modeling using ecosystem assessment tools should be utilized for ecosystem service measurement. The following steps outline the expectations for biophysical measurement of ecosystem services:

1. *Determine the method of measurement, metrics, and tools to be used*

Measuring the biophysical quantity of the ecosystem service production requires understanding the dynamics and processes that produce ecosystem services, translating this understanding into mathematical functions or models, and collecting good quality data from the NAC to populate the models. This is the core objective of this step.

Although supply and use tables, as outlined in SEEA EA, are not required for a NAC, the process of putting these tables together will help frame the study to derive conceptually appropriate and transparent methods and results. To ensure relevance and transparency in measurement approach and methods, it is required that a logic chain (see examples in Annex 6.1 of SEEA EA) and/or a conceptual model is provided in the Technical EP Study, outlining the main factors or components of the ecosystem considered, the relationships between these components and the generation of ecosystem services, direction of flow (between ecosystem components and structures, external factors, and potential users), outputs, and underlying assumptions for the derivation of ecosystem service values in the context of a NAC.

To ensure accuracy in the study of biophysical processes, it is recommended that the NAC engage subject matter experts on each service (e.g., hydrologists for water services, agro-ecologists for biomass production and pollination, fisheries experts) in order to set up appropriate measurement methods and identify indicators and data sets that are suitable to measure each ecosystem service in that location. Section 6.4 of SEEA EA and **Table 2** below provide general recommendations on measurement methods and concepts. Also, some tools have already developed systematized methods (functions or models) to measure the production of ecosystem services, which can be used in this step. SEEA's Guidance for Biophysical Modelling identifies models suitable for different ecosystem services.[26] For example, the INVEST[27] and ARIES[28] tools provide models for several ecosystem services included in the list of 38 ecosystem services to be considered by a NAC. These models identify critical biophysical

[26] United Nations (2022). *Guidelines on Biophysical Modelling for Ecosystem Accounting*. United Nations Department of Economic and Social Affairs, Statistics Division, New York.

[27] Natural Capital Project. (2022). InVEST 3.13.0.post5+ug.gce76c6e User's Guide. Stanford University, University of Minnesota, Chinese Academy of Sciences, The Nature Conservancy, World Wildlife Fund, and Stockholm Resilience Centre.

[28] Villa, F., K.J. Bagstad, B. Voigt, G.W. Johnson, R. Portela, M. Honzak, and D. Batker. (2014). A methodology for adaptable and robust ecosystem services assessment. *PLoS ONE 9(3)*:e91001. ARIES FOR SEEA Available at: https://aries.integratedmodelling.org/aries-for-seea-user-guide/

parameters that determine ecosystem service provision, the expected relationship between these parameters, and outline data needs. Locally relevant models can also be used or built by the analyst conducting the ecosystem service assessment. The most reliable measurement methods should be chosen based on their accuracy and reliability, data available, and the need to conduct annual reports.

Both the actual flow supplied and used by different beneficiaries must be measured, and when relevant, the capacity of the ecosystem to produce the service should be measured. Information on the ecosystem service flow will be needed to derive the annual reporting materials for that service. Information on the capacity to produce (see Section 6.5 of SEEA EA) will be used as a complementary indicator to be considered in the estimation of asset values. Capacity to produce indicators will be relevant for ecosystem services that can lead to ecosystem degradation (e.g., provisioning services or recreational uses). For example, fish catch is a measure that may be used to report the use value of wild fish. However, the current reproductive rate of said fish species is a measure of the capacity to produce that service that complements the analysis of this service, particularly with regards to the ability to continue providing this service in the future. Thus, when ecosystem services are prone to creating ecosystem overuse, an indicator on the capacity to produce should be included as an indicator of the sustainability of that service. The guidance provided in Section 6.5 of SEEA EA should be followed when interpreting and measuring ecosystem capacity. In some cases, information on biophysical capacity to produce an ecosystem service can also be used to derive an option value for said service.

When measuring the physical flow of ecosystem services, one must determine what would be provided in the absence of the ecosystem in its current state (the baseline). As outlined in SEEA EA, the measurement should reflect the total amount of ecosystem service produced every year (e.g., the total amount of fish produced and/or caught every year). This is different from measuring the change in the flow associated with a particular action that yields a marginal value.[29] For purposes of valuing natural assets, it is recommended that the valuation is established relative to a counterfactual baseline where there would be nothing provided (e.g., a value of zero). When a value of zero is difficult to establish, the baseline can be modeled as if the ecosystem were barren land. Table 7.7 in SEEA EA gives recommendations for baselines by ecosystem service type. The baseline assumption should be clearly stated in each instance. Overall, the measurement of the ecosystem flow will reflect the full amount of the ecosystem services provided over a full year (the accounting period).

Once tools and models have been identified and set up, measurement should become a more streamlined process for reporting in the years following the initial valuation. Since consistency with previous years' valuations should be maintained when measuring ecosystem services, subsequent analyses will be expected to adhere to previous methods and focus on updating data sources to reflect annual changes. If new markets develop, new data or information becomes available, previous information is no longer available or relevant, valuation techniques improve, or if market conditions change, a

[29] United Nations et al. (2021). *System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA)*. White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting

change in methods will be justified, provided the justification is clearly presented in the Technical EP Study.

Table 2. Recommended Measurement Methods by Ecosystem Service Categories

ECOSYSTEM SERVICE CATEGORY	RECOMMENDED MEASUREMENT METHOD(S)
PROVISIONING SERVICES	Measurement should be done in terms of the physical flows or outputs that are produced by ecosystems (e.g., total weight of fish caught). These realized flows should be complemented with information on the capacity to produce the ecosystem service in order to verify the sustainability of ecosystem service use and any impact on the condition of the ecosystem supplying the service (e.g., fish stock or fish growth rates assessed for the species).
REGULATING AND MAINTENANCE SERVICES	Regulating services are often measured through the functions or processes performed and therefore require careful characterization of the structural and dynamic factors that allow the ecosystem to function. A conceptual model or logic chain that outlines the relationships, direction of flow, and underlying assumptions must be presented. Soil, air, and water quality changes (used to evaluate several ecosystem services) should be measured in terms of concentrations at a given site and enabled by the ecosystems being studied and in reference to levels desired or required by different users (e.g., recreation activities). These should be presented in units compatible with the valuation method (e.g., yearly averages). Pollination can be measured as the rate of pollination and/or number of pollinators. Flood regulation may require data on expected storms and their intensity and a measure of the characteristics of the ecosystem providing the service (e.g., vegetation density). Most regulating services will require measurement at fine spatial scales and require some biophysical modeling (e.g., hydrological balances for water regulation or sediment transport for soil erosion and/or water quality parameters). Often measures may need to be translated into an index or indicator that can be used for valuation (e.g., pollutants in water quality may need to be mapped to a water quality ladder outlining measures as indicative of good, fair, or poor water quality).

CULTURAL SERVICES	Cultural services are measured by the number and type of interactions with the natural amenity – therefore measurement is tied to the use of the ecosystem. When possible, an attempt should be made to integrate a measure of the quality and condition of the ecosystem and/or its capacity to sustain these services, in order to enrich the analysis.
NON-USE VALUES	Since non-use values, and sometimes option values, are not dependent on current uses, these values can emphasize the value of biophysical production without having to equate them to their use (e.g., hectares of the ecosystem).

2. *Collect the data for biophysical measurements*

Once measurement methods have been selected and data needs have been identified, primary data (through field observations, surveys, or remote sensing) and secondary data from authoritative sources (e.g., official government data, data used for published work, recognized global data sources used by subject matter experts) must be collected. To determine what data should be included and assure its quality, the following criteria should be followed:

- Accuracy (is the data correct?)
- Completeness (what does it cover and not cover?)
- Reliability (does it contradict trusted data sources?)
- Relevance (is the data needed for the calculations that will be applied?)
- Timeliness (how recent is it? can it be used for annual reporting?)

Once data is identified and collected, the analysis is conducted through the chosen method and/or model. The initial study will likely require more time to identify data and set up measurement processes. Often benchmark measures will be established in the initial years of a NAC's reporting materials and subsequent analyses will use these indicators to estimate changes over time. Given that annual reporting on ecosystem service values is required, methods and data sources should be streamlined to ensure consistency, using key indicators and data proxies that can be updated on an annual basis. Changes in the amounts of ecosystem services supplied (and/or used), relative to the previous period, must be noted, including an explanation of the reason for the observed changes.

Data gaps and underlying assumptions must be clearly outlined in the method description. If data gaps exist, preventing the measurement of identified ecosystem services, an expert informed desktop analysis, combined with authoritative secondary data, may be used to conduct the valuation. If there are gaps that cannot be filled with this approach, a transparent and clear justification for the exclusion of identified ecosystem services must be provided. In addition, ecosystem services identified but not measured and/or valued must be listed in the Footnotes of the Natural Production section of the EPR and the reason for their exclusion noted in the Methodological Notes column.

An analysis of error and uncertainty must be provided for every ecosystem service quantified. This can be done through a sensitivity analysis, focusing on the parameters of greatest uncertainty and largest influence on the results. It can also be done through a probability distribution assessment (e.g., a Monte Carlo assessment), with the aim of illustrating the range of results that are possible. Expert elicitation methods may also be used to assess potential sources of error and the magnitude of uncertainty around the results. In addition, a qualitative description of potential errors and known uncertainties should be provided. If a quantitative assessment of error and uncertainty is not possible, a qualitative assessment will be required.

3. Standardize measurement units

The time and spatial dimensions of the measurement analysis must be determined using a scientifically defensible method and must be clearly stated in the reporting materials. Often, the biophysical units of measurement of a given ecosystem service may not be compatible with valuation frameworks due to the use of different time and spatial dimensions (e.g., water flow may be in volume per second, yet economic valuation may require data on average consumption per year). In these cases, biophysical data must be translated into units suitable for valuation, which in the case of NACs entails compatibility with annual values attributable to spatial units found within the NAC (e.g., hectares or acres). It may be the case that a given yearly measure requires information about longer ecological cycles to better interpret the result and the observed trend. In this case, the treatment of this information should be transparently presented and contextualized using expert judgement, with the intent of accurately presenting the larger trend in ecosystem service production. The exact measurement unit to be presented for each ecosystem service will depend on the ecosystem service, data availability, and the method used for measurement. Annex 6.1 of SEEA EA provides some examples of potential physical units (metrics) for different ecosystem services.

OUTPUTS:

- A table with results for the biophysical quantification of ecosystem service production.
- A description of the methods used for measurement, error and uncertainty analyses, observed changes from previous accounting periods, and conceptual models outlining the scope and logic behind the analysis of ecosystem service provision.
- A database with data collected for analysis, data sources, and workbook with measurement results standardized with clearly defined units that include spatial and time dimensions.

Step 6. Assign an Economic Value to the Ecosystem Services

The next step is to value the ecosystem services produced within the NAC during the accounting period based on accepted methods and best practices within the discipline of ecosystem service valuation ("ESV") and with the aim of providing the TEV of the ecosystems managed by such NAC. At this step, the physical units of ecosystem services are given a dollar value to represent the economic contribution to an economic unit. More specifically, the valuation method will seek to estimate the economic value obtained by a given set of beneficiaries from the different flows of ecosystem services supplied by the NAC. Supply and use tables (as recommended in SEEA EA) will be useful to establish these links and to determine the ecosystem service contribution of different ecosystem types, as measured in the biophysical flow analysis. Depending on the method, additional data may be needed to reflect the number of beneficiaries, their economic relationships to the asset, their willingness to pay for or accept the ecosystem service being supplied, and other socio-economic, demographic, or market data that determine ecosystem service values. In many cases, the biophysical measurement approach will be closely intertwined with the valuation approach. For example, coastal flood regulation may be measured in terms of the vegetation present and its ability to reduce flood levels within exposed (and economically valued) structures. In other cases, the valuation method will entail a discrete next step to assign an economic value to the amount of ecosystem service produced and measured in the previous step.

SEEA EA provides valuation guidance for ecosystem service flows in Chapter 9 and more recently through a valuation methods report that was released to further elaborate on this guidance, based on countries' experience with natural capital accounting.[30] In addition, given that NACs will seek to also capture option values and the non-use values of nature as well as consumer surplus contributions, NACs may also report these types of economic values as noted in the relevant sections of Chapter 12 of SEEA EA (guidance referring to consumer surplus value calculation and reporting as well as that for non-use values). The information on ecosystem service values will be used to report on the annual Natural Production section of the EPR.

There are many methods for conducting ESVs as outlined in Section 9.3 of SEEA EA and in Chapter 3 of SEEA EA's valuation methods report.[31] **Table 3** below highlights some of these methods, [32] given their relevance to NACs.

[30] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York

[31] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York

[32] United Nations et al. (2021). *System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA)*. White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting

Table 3. Recommended Valuation Methods for a NAC[33]

DIRECT MARKET METHODS: Observable markets with direct market prices.
Where well-functioning markets exist for ecosystem services (there is competition and minimal price distortions), prices can be used to represent the ecosystem services value. For example, fees paid to landowners for hunting leases may reflect the value placed on the ecosystem's production of wildlife provisioning services (hunting). Most ecosystem services are not currently provided in markets. In cases where markets exist, prices tend to underestimate the TEV of the ecosystem service. Also, given that certain goods and services are often provided by public institutions or are highly regulated (e.g., water supply), the prices for these services may be distorted and may need to be complemented or substituted with another valuation method that provides a more meaningful measure of the TEV of the ecosystem service. If the price paid embodies other significant factors of production (e.g., inputs, labor, technology), an indirect market price method should be considered, such as residual value estimates.
INDIRECT MARKET METHODS: Prices in related markets are used as proxies.
Referential markets: In the absence of a direct market for the unique good or service, a similar marketed good or service can be used to infer the value. The good or service should be sufficiently similar. For example, in subsistence economies, prices for the same products traded in markets (e.g., fish harvest sold at nearby ports) can be used to estimate the value of the good (e.g., fish) obtained for one's own consumption. If there are significant added costs (inputs from other factors of production), those should be deducted from the reference price.
Residual values and resource rent methods: If the price of a final good embodies the ecosystem service but also includes other significant factors of production (e.g., labor and technology), these should be subtracted from the price to isolate the contribution of nature. These methods estimate a value by taking the gross value of the final marketed good to which the ecosystem service provides an input (e.g., crops) and deduct the cost of all other inputs, including labor, produced assets, and intermediate inputs.
Productivity or production function methods: In this method, the ecosystem service is considered an input in the production function of a marketed good. Thus, changes in the service will lead to changes in the output of the marketed good, holding other things equal. The value of the service is determined by first estimating the marginal product (contribution) of the ecosystem service as the change in the value of production as a result of a marginal change in the supply of the ecosystem service.

[33] Descriptions of most of these methods are based on the descriptions provided in United Nations et al. (2021). *System of Environmental-Economic Accounting Ecosystem Accounting (SEEA EA)*. White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting

Then, the marginal product is multiplied by the price of the marketed good to derive a marginal value product for the ecosystem services. Third, this marginal value product is multiplied by the physical quantity of the provided ecosystem service to obtain the value of the ecosystem service. It is often used to estimate the value of water supply or pollination to agriculture.

Hedonic price valuations: This method estimates the differential premium on property values or rental values (or other composite goods) that arises from the effect of an ecosystem characteristic (e.g., clean air, local parks) on those values. This method is commonly used to measure the amenity services provided to residents in particular locations. In order to obtain a measure of this effect, all other characteristics of the property (including size, number of rooms, central heating, garage space, etc.) are standardized and need to be included in the analysis. Consideration should also be given to the geographical, neighborhood, and ecosystem characteristics of the properties.

REVEALED PREFERENCE METHODS: Uses consumer purchasing decisions and/or observed behavior to infer values for ecosystem services.

Averting behavior: This method uses expenditures or observed behavior to prevent or mitigate a negative effect of an environmental impact. These expenditures (including time spent) are used to represent the value of the ecosystem service. Examples of this include extra expenditures to improve water quality or air quality.

Travel cost: This method is commonly used to value the recreational value of a given site. The cost of travel and opportunity cost of visitors' time to a given recreational or cultural site is collected and used to build a demand curve to infer the implicit price of the ecosystem service (e.g., recreation). The area under the demand curve provides a measure of the willingness to pay (measured through the expenditures and time spent of different visitors) to visit the site. The method is similar to the estimation of a demand curve based on the quantity demanded at different prices. SEEA EA provides guidelines to estimate different value concepts using this method.

COST-BASED METHODS: The cost of damages that would be incurred by communities in the absence of ecosystem services.

Replacement costs: Estimates the cost of replacing the ecosystem service through something that provides the same contribution to benefits. It is also known as the substitute cost or alternative cost approach. The substitutes can be either a consumption item (e.g., an air filtration unit for a household substituting for air filtration services of trees) or an input factor (e.g., sorghum substituting for non-priced forage in the case of a rangeland grazing ecosystem services) or a capital factor (e.g., water treatment plant). In all cases, if the substitute provides an identical contribution, the price of the ecosystem service is the cost of using the substitute to provide the same benefits as provided by a single quantity unit of the ecosystem service (e.g., price for a ton of forage).

Avoided costs: The cost of damages that would be incurred by communities in the absence of ecosystem services. Often, expected damage functions are built based on historical data of damages associated with different levels of ecosystem service provision. This method is often used to estimate storm protection benefits provided by natural areas (such as wetlands). Historical data for storm damages can be regressed depending on wetland extent, controlling for factors such as storm intensity, population density, and exposure factors.

Mitigation or restoration costs: The costs of recovering from and preventing further damages due to ecosystem degradation. This valuation method is common in legal settings evaluating environmental damages.

STATED PREFERENCE METHODS: Often used in marketing studies, these methods are based on rigorous surveys asking respondents their willingness to pay or willingness to accept payment for the provision of different levels of ecosystem services. These are often used to estimate consumer surplus and non-use values.

Contingent valuation: Survey-based stated preference technique that elicits people's behavior in constructed markets. In a contingent valuation questionnaire, a hypothetical market is described where the good/service in question can be traded.

This contingent market defines the good itself, the institutional context in which it would be provided, and the way it would be financed. Respondents are asked about their willingness to pay for, or willingness to accept, a hypothetical change in the level of provision of the good, usually by asking them if they would accept a particular scenario. Respondents are assumed to behave as though they were in a real market.

Choice modeling or conjoint analysis: Surveys that isolate levels of the environmental good or service in order to build a valuation function based on multiple data points collected in different contexts presented in the survey. An individual is offered a set of alternative levels of supply of goods or services, in which the characteristics vary according to defined dimensions of quality and cost. By analyzing preferences across these different bundles of characteristics, it is possible to obtain the value placed by the individuals on each of the characteristics, provided: (i) the bundles include a cost variable; and (ii) a baseline bundle is included that represents the status quo.

BENEFIT TRANSFER METHOD: The use of existing data from published valuation studies to infer the value of an ecosystem or service. This method draws on the valuation methods above and can be adopted when primary data is lacking.

The benefit transfer method uses secondary data (i.e., published data) to estimate the value of a service at a target site. Similar to a house appraisal valuation, where "comparable sales" are used to predict the house's current value, this method uses comparable sites to predict ecosystem service values that lack primary data. The value can be refined to adjust for specific variables that may influence its value, such as size of the asset or income effects, through a function transfer method.

The valuations conducted for each ecosystem service must clearly state the value obtained and the estimated level of confidence placed on the valuation conducted. The value types obtained through different valuation methods must be categorized according to the TEV concept as well as the adopted method for valuation. In the TEV concept, ecosystem services are valued with respect to their uses by different beneficiaries (direct and indirect uses) and ecosystems can also be valuable to society simply because of their existence (non-use values) or the value placed in having the option to benefit from it in the future (option value).

The application of a given ESV method will be based on the ecosystem and ecosystem service type, the type of economic value that is believed to be most material, and the data available. Above all, a NAC must prioritize relevance, rigor, consistency, and transparency in the methods used, value types captured, and underlying assumptions to allow reviewers to accurately interpret the values obtained and compare them through time and to other NACs. The chosen method for each ecosystem service must be well-justified, researched, and explained, including the scope of the valuation, key assumptions, and limitations of the study.

Sections 4.2 and 4.3 of SEEA EA valuation methods report[34] provide extensive guidance on the selection process of valuation methods for different ecosystem service types and the types of value that different methods capture. Following this method prioritization process to derive a set of core values for a NAC is required, unless a different method will clearly yield more relevant information or rigorous and accurate values in such NAC's reporting materials. In addition, NACs have the added option of using stated preference methods to report consumer surplus and non-use values if these are deemed relevant to the value of a NAC.

In general, SEEA EA prioritizes methods that measure exchange value as the value concept as well as methods that are based on observable inputs. This approach will often provide a conservative value and will capture measures that are comparable to market prices as used in financial accounts and with other asset classes. For these reasons, exchange value concepts and corresponding valuation approaches (as stated in SEEA EA core guidance) should also be prioritized in the valuation of a NAC's ecosystem services. These will serve as the base values of the NAC. More specifically, SEEA EA's hierarchy of method prioritization, as is stated in their guidelines, is as follows:

- Methods where the price for the ecosystem service is directly observable

[34] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York

- Methods where the price for the ecosystem service is obtained from markets for similar goods and services
- Methods where the price for the ecosystem service is embodied in a market transaction
- Methods where the price for the ecosystem services is based on revealed expenditures (costs) for related goods and services
- Methods where the price for the ecosystem service is based on expected expenditures or markets

It is important to note that while market-based methods can yield numbers that are more comparable to other financial assets and as such they are to be used to derive the core values of a NAC, these often exclude indirect use values, non-use values, and consumer surplus, which are all important benefits associated with natural ecosystems. For these reasons, these value concepts and other valuation methods (beyond the core recommendations of SEEA EA) are often helpful to complement the valuation of a NAC. Particularly, when consumer surplus is believed to be high and/or there are few market interactions, a willingness-to-pay measure may be considered to complement or conduct the valuation. Also, if option or non-use values are identified and measurable, these should be estimated and included. When these additional valuations are conducted, they should be done transparently, following the structure and reporting format of SEEA EA (Chapter 12) and its valuation methods report,[35] avoiding double-counting, and noting the type of value captured.

If there are data gaps leading to the exclusion of identified and material ecosystem services, a desktop valuation should be conducted to provide an approximation of the potential value of that ecosystem service. A desktop analysis is different from a desktop assessment by being more thorough and in-depth than the initial assessment. It may include modeling using secondary data and/or the use of benefit transfer methods. Following the guidance provided in section 6.1 of the valuation methods report,[36] benefit transfer methods may be used, when sufficient data may not be available to conduct a prioritized valuation method. If a desktop analysis is included to complement or conduct the valuation, the values must be derived in a rigorous manner, accounting for potential sources of errors and uncertainty and including various quality assurance methods. It is expected that in subsequent years, benefit transfer estimates will be replaced by a primary valuation method. The use of less preferred methods, such as benefit transfer, must be clearly labelled as a lower tier valuation, with more inherent uncertainty. Once a preferred method (based on SEEA EA's guidance and on the objective of providing relevant, accurate, and complete information about the natural assets) is possible and conducted, the obtained value will be labeled as a higher tiered valuation with more certainty. In the event that a desktop analysis is not possible due

[35] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York.

to data gaps, the reason for excluding the ecosystem service must be clearly presented and justified.

When conducting the valuations, there should be a review to avoid double counting. Values that are already generating revenue to a NAC and that are reported in the financial reporting (i.e., GAAP/IFRS financial statements) must not be included in the EPR. Other guidelines for avoiding double counting, as outlined in SEEA EA must also be followed. These guidelines relate to the adherence to the definitions of ecosystem services provided, to the potential overlap in the valuations of intermediary and final services, and to the assignation of values to different ecosystem types. Note that SEEA EA's guidelines for incorporating intermediary services must be followed.

An error and uncertainty analysis must be carried out for the valuation process. For example, multiple valuations may be conducted for the same ecosystem service flow, with the goal of validating the results obtained. If there are values with large margins of error, there must be at least one other validation method conducted. This can be in the form of a sensitivity analysis, a probability distribution analysis, or an expert elicitation method. Values obtained for validation purposes must be presented separately and used to illustrate the range of potential values expected for a given service and the level of confidence placed on a given valuation. If a quantitative assessment of error and uncertainty is not possible, a qualitative assessment of potential sources of error and inherent uncertainty will be required.

Overall, SEEA EA's prioritization of methods should be adopted and combined with the guiding goals of presenting the most accurate, relevant, consistent, comparable, timely, and complete information possible. If multiple valuations for the same ecosystem service flow are deemed additive (i.e., they are mutually exclusive and pose no risk of double counting) they may be presented separately, with notes on why these values are deemed additive and what type of economic values they represent.

Since the objective of a NAC is to present the TEV of the ecosystems managed by the NAC, the types of values sought and obtained through the valuation method must be clearly and transparently noted as part of the method and value description. The Technical EP Study must justify the decision to adopt a given valuation method. By noting whether it is a direct use, indirect use, option, or non-use value, as well as the level of confidence associated with the calculations conducted, a more accurate interpretation of the results will be enabled. Transparent and clear information on value types will help reviewers understand the completeness of the valuation, potential revenue flows that may emerge from the ecosystem service, as well as the type of value being captured in the valuation conducted. The valuation must also be replicable to facilitate the quality assurance process and ensure consistency in subsequent valuations for future reporting.

In general, a pilot study or test run should first be conducted to test and validate the model being used for the valuation of each ecosystem service. If a statistical model is being used, the sample size must render results that are representative of the target population. The statistical model must be reviewed for potential errors and tested and validated. Descriptive statistics should be provided as well as econometric results. If secondary data is being used, validation methods must be conducted.

Given that NACs will have to report on the value of their natural assets every year, the valuation process should be streamlined to produce consistent estimates every year. Regularly updated data should be prioritized to support meaningful annual reporting. If some variables cannot be updated every year (e.g., replacement costs of using alternative technologies or survey-based valuations), the year when the data was collected must be transparently noted and the method must aim to reflect current conditions, using expected trends if current year data is not yet available. It may be the case that biophysical data can be updated more frequently than the value per unit (e.g., water quality data may be more frequently measured than the economic value of that water quality). In this case, the change in the biophysical measure would be updated and the value per unit would be maintained constant or extrapolated, noting the year for each data point. If changes in values are observed relative to a previous accounting period, those must be noted and explained.

The values derived for each ecosystem service will be presented as an annual flow of economic value, differentiated by the contributions of different ecosystem types managed by the NAC. Spatial variations as outlined in section 7.3.1 and in section 9.5 of SEEA EA must be considered when attributing ecosystem service values to different ecosystem types.

OUTPUTS:

- A table with annual values per ecosystem service per ecosystem type, including the type of TEV captured.
- A summary of the error and uncertainty analyses per ecosystem service value and, if possible, a range of values possible with the methods employed.
- A clear description of the methods employed, data sources, and best practices followed. In addition, if value changes are observed relative to the previous accounting period, these must be noted, including the reason for the observed change.
- Models used and data used in their original format with the purpose of aiding replication of the analysis during the review process.

Step 7. Calculate the Value of the Assets

To calculate the economic value of the natural assets managed by a NAC, the flow of ecosystem service values provided by the different assets held within the NAC must be aggregated. This involves aggregations based on the expected level of ecosystem service flows through time, aggregations at the level of the asset (ecosystem type), and aggregations across assets (all ecosystems managed by the NAC). These aggregations must be done in a transparent manner to enable investors to trace the different components of the asset valuation and following SEEA EA guidance to avoid double counting.

Therefore, for the asset value calculation, once the current annual economic value of ecosystem services has been determined (in Step 6), as enabled by different ecosystem types, the next step will entail calculating the expected future flows of ecosystem services and their corresponding values. This will be done through a Net Present Value ("NPV") calculation, which will be used to estimate the value of the ecosystem as an asset, based on the multiple ecosystem services a given asset provides and expects to provide. The use of the NPV formula to calculate an asset value is consistent with the SEEA EA approach, which describes NPV as follows:

"The net present value (NPV) is the value of an asset determined by estimating the stream of income expected to be earned in the future and then discounting the future income back to the present accounting period.[37] In ecosystem accounting, it is applied by aggregating the NPV of expected future returns for each ecosystem service supplied by an ecosystem asset."[38]

The formula for calculating NPV is:

$$NPV = \sum_{t=1}^{n} \frac{R_t}{(1+i)^t}$$

Where:

R_t = Net cash inflow or outflow in period t

i = Discount rate

t = Number of time periods

Therefore, assets will be valued by taking the sum of the discounted future flows of ecosystems service values. Each unique ecosystem type should be presented separately as a natural asset with its corresponding NPV. The total asset value will correspond to the boundaries of the NAC and the set of ecosystems within it.

There are three important considerations when calculating an NPV for natural assets:

1. the amount and/or value of future streams of benefits in comparison to the present assessment,

[37] United Nations (2014). *System of Environmental-Economic Accounting 2012—Central Framework*. Page 151 para. 5.110.

[38] United Nations et al. (2021). *System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA)*. White cover publication, pre-edited text subject to official editing. Pg. 184. Available at: https://seea.un.org/ecosystem-accounting.

2. the life of the asset (the length of time over which an ecosystem is expected to generate ecosystem services), and

3. the discount rate (representing the opportunity cost of money and time preferences of the beneficiaries).

1. The amount and/or value of future streams of benefits:

As a default, the amount and the future value of ecosystem services may be assumed to be the same as they are in the current accounting period. In the initial reporting periods of a NAC, an average of recent years (e.g., 3 to 5 years) may be used to establish the current biophysical realities and to better understand expected trends. If sufficient information is available to project demand and supply dynamics for different ecosystem services in the future, with a high degree of certainty and a reliable approach, these may be incorporated into the NPV equation used for the asset valuation. SEEA EA provides guidance (see Section 10.3.4 and in NCAVES and MAIDA 2022, Section 5.2.4) on the factors that should be considered when conducting future projections. All factors considered must be transparently disclosed, including any significant assumptions that drive the obtained value, and the certainty placed in these assumptions must be clearly noted. In the NPV calculation, special attention must be paid to identifying and incorporating any reliable information available to the NAC that can translate into a reduction in the amount of ecosystem services supplied or used in the future (e.g., expected climate change induced changes). Factors pertaining to assumptions regarding the impact of expected land management practices by the NAC should not be included in future projections of supply and demand.

Alternatively, if demand and supply projections are deemed uncertain, difficult to incorporate into the ecosystem service models or NPV calculation, or sensitive to the modeled assumptions, these projections may be calculated separately, in the form of scenarios, and may be included separately in the NAC's public disclosure documents filed with the SEC. Future demand and supply projections for the ecosystem services included as well as other expected changes in the NAC's values are not required elements in the EPR but a NAC should consider whether it has information of this nature that constitutes material disclosures to include in its public disclosure documents. If there is no reliable information about future projections, the amount and/or value of ecosystem services in the future may be assumed to be the same as today.

If supply or demand projections for the future change relative to the previous accounting period, the nature of this change must be transparently stated.

2. The life of the asset:

As noted in the valuation guidelines report[39] and in Section 10.3.5 of SEEA EA, the asset life should be based on the condition of the ecosystem asset and its capacity to supply the ecosystem services being valued, based on likely patterns of use (rather than on assumptions about intended land management practices). If an ecosystem type has high performing condition indicators and ecosystem services are being sustainably managed (per the capacity to produce indicators), the valuation can assume a long asset life, which can be set at 100 years, as recommended in SEEA EA's valuation guidance.[40] If ecosystem condition metrics show a degraded ecosystem, for example, the asset life should be set accordingly. Similarly, if the capacity to produce indicators show a current unsustainable use pattern, the ecosystem life should reflect the time at which the ecosystem may become compromised and limit the valuation to that time horizon. If the time horizon is uncertain, a conservative asset life should be adopted, clearly delineating the calculations used and any assumptions taken to estimate the asset life. Calculations of the asset life should be coherent with the information and modeling used for the estimation of future amounts/values of ecosystem services.

If the asset life changes relative to the previous accounting period, the reasons for the change must be clearly stated and the specific variables that contributed to this change must be transparently noted.

3. Discount rate:

With respect to the discount rate, NACs should use a constant 2% discount rate as a default. The rationale for a low discount rate relates to the objective of measuring and reporting on the collective benefits supported by NACs. Natural assets are long term, productive assets that can generate collective benefits over very long periods of time. By using a consistent and low discount rate, NACs will transparently show information about future ecosystem services, which may be used and interpreted as a reference line when investors are evaluating a NAC's asset value, in conjunction with other information reported by the NAC. A constant discount rate will ensure consistency and comparability across the different asset valuations and across different NACs and follows a standard approach often used by SEEA EA to illustrate NPV calculations.[39]

The results of the NPV calculations must be recorded in the Natural Assets section of the EPR. These should be broken down by ecosystem type and where relevant they should be justified by indicators of the ecosystem's capacity to produce ecosystem services. In addition, the use of condition indicators to calculate asset life must also be transparently and clearly explained. All calculations and variables used must be clearly presented in the NAC's Technical EP Study that documents the ecosystem service valuations.

[39] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York.

[40] NCAVES and MAIA (2022). Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York.

OUTPUTS:

- Net Present Value calculations for natural assets.
- A table outlining the attribution of economic value to each natural asset, disaggregated by each ecosystem service.
- When relevant, indicators of ecosystem capacity to produce ecosystem services, for services that are prone to ecosystem overuse or degradation.
- A description of the methods used to calculate asset values, the results of the calculations, and any other information considered in this section, including the treatment of ecosystem condition metrics in determining the asset life. If the asset economic value changed relative to the previous accounting period, the reason for the change should be clearly noted.
- If applicable, notes on future threats, shifting baselines, and potential changes in ecosystem service production and value given the information available during the current accounting period, including margins of error or value ranges for the assets considered.

COMPONENTS AND FORM OF THE ECOLOGICAL PERFORMANCE REPORT

On an annual basis, each NYSE-listed NAC must publish an EPR with statistical information on its ecological performance, comprised of sections with data on (i) Natural Production, (ii) Natural Assets, and (iii) Underlying Asset Condition. The information used to populate an EPR will be obtained from the Technical EP Study conducted to characterize, measure, and value a NAC. Each section will include information on the current accounting period, and the previous period where applicable.

Natural Production Section

The Natural Production section of the EPR provides information on the annual flows of ecosystem services provided by the natural assets under management by a NAC in both biophysical and economic terms. This section will present the amount of ecosystem services and their corresponding economic value by ecosystem type. However, a summary of this section may be created to present the total amount of ecosystem services across ecosystem types and their corresponding economic value, aggregated at the level of the NAC. See **Appendix A** for a template of the EPR with the Natural Production section with example data.

Components of the Natural Production Section:

- **Flows of Ecosystem Services** – All the ecosystem services that were measured and valued in the NAC itemized, from a base list of 38 potential ecosystem services.

- **Biophysical Measure** – The amount (quantity) of ecosystem service supplied, measured in biophysical units. The appropriate measurement unit will depend on the ecosystem service type. The quantity of ecosystem services will reflect the total amount valued and included in the ecosystem service valuation. When total units are not relevant indicators, then an average value can be provided (e.g., average temperature reduction across the landscape).

- **Total Annual Economic Value** – The total economic value derived for each ecosystem service through the economic valuation conducted for the NAC. This value must be presented in current dollars.

- **Net Change** – The difference in annual economic value between the current accounting period and the previous accounting period.

Natural Assets Section

The Natural Assets section reports information on the potential future production value of natural assets managed by a NAC. This will be measured through the Net Present Value of ecosystem service value flows. See **Appendix A** for a template of the Natural Assets section of the EPR with example data.

Components of the Natural Assets Section:

- **Natural Assets** – The particular ecosystem types being managed by the NAC.

- **Asset Life** – The asset life of each natural asset in years, based on the ecosystem condition of the asset in the current accounting period and in some cases, capacity to produce indicators.

- **Net Present Value** – The total economic value of the assets under management (in current dollars), calculated using the NPV method. This represents the expected future flow of ecosystem services based on the current asset's condition and production capacity.

- **Net Change** – The difference in the asset value between the current accounting period and the previous accounting period.

Underlying Asset Condition Section

The Underlying Asset Condition section of the EPR provides biophysical information on the extent and condition of the ecosystems being managed by a NAC based on the current accounting period. The expected approach, methods, and units are described in Step 2 (Determine Ecosystem Extent) and Step 3 (Determine Ecosystem Condition) of this document (Exhibit 3). See **Appendix A** for a template of the EPR with example data, including the Underlying Asset Condition section (based on the SEEA EA Online supplement: SEEALand Stylised Example).[41]

Overall, ecosystem condition reporting involves a progressive building of metrics, beginning with condition variables, then condition indicators, and finally condition indices. If a phased approach is taken to report on condition metrics during the initial years, the reporting on these metrics in the EPR may be simplified to show only the metrics reported for that accounting period where applicable. SEEA EA provides examples of templates to illustrate the reporting of variables only "stage 1," variables and condition "stage 2," and variables, condition and indices "stage 3."[42]

Components of the Underlying Asset Condition section include:

- **Ecosystem Type** – The type of ecosystem being reported on, also referred to as natural asset type.
- **Extent** – Total area by ecosystem type, for both the previous and current accounting periods.
- **Spatial Unit** – The spatial unit used to measure the extent of the ecosystem type, which can be in hectares or acres.
- **Notes** – Explanation of what factors drove the change observed in extent from the previous to the current accounting period (e.g., restoration).
- **Variable Descriptor** – The quantitative metric selected to describe an individual characteristic of the ecosystem asset (e.g., soil organic carbon, tree species richness).
- **Measurement Unit** – The measurement unit for the condition variable values.
- **Variable Value** – Value for the condition variable descriptor.
- **Net Change** – The difference between the variable values from the previous to the current accounting period.
- **Indicator Values** – Values for the condition indicators, corresponding to the variable descriptor and a reference level, reported for both the previous and current accounting period.
- **Net Change** – The difference between the indicator values from the previous to the current accounting period.

[41] United Nations et al. (2021). *System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA)*. SEEA EA Online supplement: SEEALand Stylised Example, Version 1. Available at: https://seea.un.org/ecosystem-accounting

[42] United Nations et al. (2021). *System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA)*. SEEA EA Online supplement: SEEALand Stylised Example, Version 1. Available at: https://seea.un.org/ecosystem-accounting

- **Index Values** – Value for composite condition indices, for both the previous and current accounting period.
- **Net Change** – The difference between the index values from the previous to the current accounting period.

Footnotes to the EPR

Footnotes will be included, in tabular form, to provide further details on the suite of calculations used to derive and interpret the Natural Production and Natural Asset sections. These Footnotes will provide transparency for the EPR values by including notes and clarifications on the calculations conducted. In particular, the Footnotes provide disaggregated information about the range of biophysical measures and valuations conducted, the types of economic values estimated, and their reliability and scope.

In the **Ecosystem Services Footnotes**, the **Flows of Ecosystem Services** will list all the ecosystem services identified in the NAC, including those that were identified as present but not valued. The reason for their exclusion must be noted in these cases. The **Biophysical Measures** segment will provide information about the measurement of ecosystem service flows in biophysical units, including the **Range of Measures** obtained for each measurement calculation from the sensitivity and/or error analyses, the **Biophysical Unit** used for these measures, and **Biophysical Methodological Notes** outlining key assumptions about the scope of the measurement, source of the data, measurement uncertainty, changes relative to previous accounting periods, and other details deemed material to the measurement. The **Annual Valuations** segment will provide information about the **Value Ranges** to note the possible range of unit values that may be used to assign a value to the ecosystem service flow, including confidence intervals or ranges from the sensitivity and/or error analyses and the **Value Units** in which the unit values are noted. **Value Type** denotes the type of TEV derived through the valuation (e.g., direct use value). The **Valuation Methodological Notes** must denote the valuation method, source of the value data, beneficiaries considered, and other key information needed to clearly interpret the valuation. The **Capacity Indicators** segment will only be applicable to ecosystem services that are prone to result in ecosystem degradation or overuse, such as provisioning services. **Capacity Indicator** will note the result or value obtained and the **Capacity Indicator Unit** will describe the units used for the capacity indicators (e.g., rate of use). The **Capacity Indicator Notes** will describe qualitatively how the capacity indicator was calculated.

In the **Natural Assets Footnotes**, **NPV Calculations** will be described. First, **NPV Methodological Notes** will describe key assumptions and factors driving the asset results obtained, including notes about the allocation of ecosystem services to asset types and assumed projections for future supply and use of ecosystem services. The **Asset Value Range** will describe the minimum and maximum values that could be derived with the information available during the current accounting period and corresponding to the ranges provided for biophysical measures, possible unit values included in the NPV calculations. **Confidence Level Notes** outline potential sources of error and uncertainty associated with the overall NPV calculations. **Total Economic Value for the Asset** will provide the final value calculated for the natural asset based on the most rigorous measures, values, and projections available, presented in current dollars.

In general, the **Footnotes** must present key details, assumptions, and limitations deemed material to understanding the values in the EPR.

APPENDIX A: ECOLOGICAL PERFORMANCE REPORT TEMPLATE

ECOLOGICAL PERFORMANCE REPORT FOR

[NAC NAME]

[REPORT DATE]

SAMPLE INTRODUCTION

This Ecological Performant Report ("EPR") for [NAC Name] contains statistical information on the ecological performance of the natural assets under the Company's management as of [report date], including sections with data on:

- Natural Production,
- Natural Assets, and
- Underlying Asset Condition.

The [Year X] Technical Ecological Performance Study for [NAC Name] conducted to characterize, measure and value the ecosystems managed by [NAC Name] was used to populate this EPR.

[Note: A NAC may elect to include additional discussion, trends, or other summary information here.]

TEMPLATE FOR THE NATURAL PRODUCTION SECTION OF THE EPR

[YEAR X] NATURAL PRODUCTION BY ECOSYSTEM TYPE					
	CURRENT PERIOD			PREVIOUS PERIOD	
FLOWS OF ECOSYSTEM SERVICES	BIOPHYSICAL MEASURE		TOTAL ANNUAL ECONOMIC VALUE ($)	TOTAL ANNUAL ECONOMIC VALUE ($)	NET CHANGE ($)
	QUANTITY	UNIT			
FOREST					
Wood					
Wild fish, plants, and other biomass					
Water supply					
Global climate regulation					
Soil quality regulation	1,250	tons of urea avoided	$1,050,768	$246,758	$804,010
Soil erosion control					
Water purification					
Pollination					
Soil formation services					
Recreation-related services					
[Others as relevant]					
SUBTOTAL					
ECOSYSTEM TYPE B					
SUBTOTAL					
ECOSYSTEM TYPE C					
SUBTOTAL					
TOTAL VALUE					

Sample data is shown for illustrative purposes only.

[YEAR X] NATURAL PRODUCTION SUMMARY					
FLOWS OF ECOSYSTEM SERVICES	CURRENT PERIOD			PREVIOUS PERIOD	NET CHANGE ($)
	BIOPHYSICAL MEASURE		TOTAL ANNUAL ECONOMIC VALUE ($)	TOTAL ANNUAL ECONOMIC VALUE ($)	
	QUANTITY	UNIT			
PROVISIONING					
Crop					
Grazed biomass					
Livestock					
Aquaculture					
Wood					
Wild fish and other natural aquatic products					
Wild animals, plants, and other biomass					
Genetic material services					
Water supply					
Medicinal resources					
Ornamental resources					
REGULATING AND MAINTENANCE					
Storm mitigation					
Global climate regulation					
Local (micro and meso) climate regulation					
Air filtration					
Soil quality regulation	2,500	tons of urea avoided	$2,101,536	$493,516	$1,608,020
Soil erosion control					
Landslide mitigation					
Solid waste remediation					
Water purification (water quality amelioration)					
Baseline water flow maintenance					
Peak flow water mitigation					
Coastal protection					
River flood mitigation					
Rainfall pattern regulation (at sub-continental scale)					
Noise attenuation					
Pollination					
Seed dispersal					
Pest control					
Disease control					
Nursery population maintenance					
Soil formation services					
Habitat maintenance services					
CULTURAL					
Recreation-related services					
Visual amenity services					
Education, scientific, and research					
Spiritual, artistic, and symbiotic services					
FLOW OF NON-USE VALUES					
Ecosystem and species appreciation / existence / bequest					
TOTAL VALUE					

Sample data is shown for illustrative purposes only.

TEMPLATE FOR THE NATURAL ASSETS SECTION OF THE EPR

[YEAR X] NATURAL ASSETS				
NATURAL ASSETS	ASSET LIFE (YEARS)	CURRENT PERIOD NET PRESENT VALUE ($)	PREVIOUS PERIOD NET PRESENT VALUE ($)	NET CHANGE ($)
Forest	100	$788,700	$905,065	$116,365
Ecosystem Type B				
Ecosystem Type C				
TOTAL VALUE				

Sample data is shown for illustrative purposes only.

TEMPLATE FOR THE UNDERLYING ASSET CONDITION SECTION OF THE EPR

[YEAR X] UNDERLYING ASSET CONDITION															
ECOSYSTEM TYPE	EXTENT		SPATIAL UNIT	NOTES	VARIABLE DESCRIPTOR	MEASUREMENT UNIT	VARIABLE VALUE		NET CHANGE	INDICATOR VALUE		NET CHANGE	INDEX VALUE		NET CHANGE
	CURRENT PERIOD	PREVIOUS PERIOD					CURRENT PERIOD	PREVIOUS PERIOD		CURRENT PERIOD	PREVIOUS PERIOD		CURRENT PERIOD	PREVIOUS PERIOD	
Forest	38	36	ha	Restoration	Vegetation water content - NDWI	index (-1 to 1)	0.31	0.29	0.02	0.66	0.65	0.01	0.67	0.61	0.06
					Soil organic carbon stock	tC/ha	100.00	95.00	5	0.4	0.38	0.02			
					Tree species richness	number	6.00	5.00	1	0.6	0.50	0.1			
					Tree cover	%	81.00	75.00	6	0.81	0.75	0.06			
					Vegetation index - NDVI	index (-1 to 1)	0.65	0.63	0.02	0.83	0.82	0.01			
					Forest area density	%	74.00	59.00	15	0.74	0.59	0.15			
Ecsosytem Type B															
Ecsosytem Type C															

Sample data is shown for illustrative purposes only.

TEMPLATE FOR THE FOOTNOTES TO THE EPR

[YEAR X] FOOTNOTES - ECOSYSTEM SERVICES

	BIOPHYSICAL MEASURES				ANNUAL VALUATIONS					CAPACITY INDICATORS		
FLOWS OF ECOSYSTEM SERVICES	RANGE OF MEASURES		BIOPHYSICAL UNIT	BIOPHYSICAL METHODOLOGICAL NOTES	VALUE RANGES		VALUE UNITS	VALUE TYPE	VALUATION METHODOLOGICAL NOTES	CAPACITY INDICATOR	CAPACITY INDICATOR UNIT	CAPACITY INDICATOR NOTES
PROVISIONING	LOW	HIGH			LOW	HIGH						
REGULATING AND MAINTENANCE												
CULTURAL												
FLOW OF NON-USE VALUES												
TOTAL VALUE												

[YEAR X] FOOTNOTES - NATURAL ASSETS

NATURAL ASSETS	NPV CALCULATIONS					
	NPV METHODOLOGICAL NOTES	ASSET VALUE RANGE ($)		CONFIDENCE LEVEL NOTES		TOTAL ECONOMIC VALUE FOR THE ASSET ($)
FOREST		LOW	HIGH	LOW	HIGH	
ECOSYSTEM B						
ECOSYSTEM C						
TOTAL VALUE						

INTRINSIC

EXCHANGE GROUP