Building the future of environmental decision making

Scoping the potential connection between the ESVD and ENCORE

Lead Organisation: Foundation for Sustainable Development (FSD)

Authors:
FSD: Victoria Guisado Goñi, Mieke Siebers, Leena Al Olaimy, Vince van ’t Hoff, Luke Brander, Thalia Ballell

Contributors:
UNEP-WCMC: Emma Calhoun, Sebastian Bekker, Sharon Brooks

Email: info@fsd.nl
Tel. +31 6 20 858225

PO Box 570, 6700 AN Wageningen
Tel: 0317 485091
Email: info@fsd.nl
CoC Arnhem: 09114686

December 2025

Executive summary

This scoping study explores how data originating from two complementary tools–the ESVD and ENCORE– could be combined in a meaningful way to stimulate private sector investment in nature. The aim of any potential integration would be to enhance how ecosystem service values are represented in financial, policy, and disclosure frameworks, thereby making nature's economic significance more visible and actionable.

The study shows the potential rationale and technical feasibility of integrating data from the two tools. Stakeholder consultations with financial institutions, regulators, and research partners revealed initial support for linking ENCORE's qualitative impact and dependency structure with ESVD's quantitative, monetary valuation data. This connection could fill a gap in current nature-related risk and disclosure approaches by providing geographically explicit, comparable data to assess nature-related exposures and opportunities, not merely from a company perspective, but also providing insights for the larger socio-economic effects.

The most promising finding is that combining data from the two sources enables location-specific prioritization neither could achieve alone. ENCORE identifies which ecosystem services matter to specific economic sectors from a business-operations perspective, while ESVD captures the total economic value of those same services to all stakeholders, communities, governments, and businesses, within a given location. This complementary relationship could transform sector-level dependencies into site-specific monetary assessments, differentiating between facilities with identical operational dependencies based on the actual value of ecosystem services where they operate. Adding a socio-economic perspective through ecosystem service valuation could strengthen double materiality analysis by connecting corporate dependencies and impacts to the broader landscape of communities, sectors, and value chains that share the same natural assets.

Three prototype use cases outlined in this report demonstrate the potential value of this practical connection.

- The Compliance Disclosure use case shows how the integrated ENCORE-ESVD data could support the estimated 50,000+ European companies required to comply with the Corporate Sustainability Reporting Directive (CSRD) once fully phased in, and companies adopting the Taskforce on Nature-related Financial Disclosures (TNFD) framework. This use case would enable automated assessments that combine ENCORE's dependency and impact mappings with ESVD's monetary valuations, streamlining the quantification of nature-related risks and opportunities for mandatory reporting.

- The Portfolio Screening use case transforms sector-level ENCORE ratings into holding-specific priorities by revealing that facilities with identical "High dependency" ratings may be located in ecosystems that have differing values to people. Such

information can inform decisions relating to investment in conservation and/or restoration efforts.

- The Project Due Diligence use case enables development banks to quantify the baseline socio-economic value of ecosystem services at project locations in data-poor regions where primary valuation studies are often infeasible.

From a methodological perspective, the report outlines how ecosystem classifications, valuation methods, suitable units of analysis and confidence levels would need to be harmonised to ensure consistent and transparent outputs. It also identifies the importance of governance, peer review, and sustainable funding to ensure long-term credibility and maintenance.

The report concludes that there is potential for combining data from ESVD and data from ENCORE in the future. However, several key questions must be addressed before continuing to explore potential integration. Any next steps should be phased and collaborative, involving a broader consortium of stakeholders. A prudent approach would begin with pilot applications and end-user testing. Combined with close collaboration with governance partners, this would validate the approach, demonstrate added value, and refine governance and licensing arrangements.

Such collaboration could serve as a step towards a more connected and transparent nature-data ecosystem. Thus supporting better-informed policy, investment, and risk management decisions for a nature-positive economy.

Foundation for Sustainable Development

ESVD ECOSYSTEM SERVICES VALUATION DATABASE

Table of Contents

Glossary

Term	Definition (in Environmental Context)	Key References
Natural Capital	*The world's stock of renewable and non-renewable natural assets — including geology, soil, air, water, and all living things — from which humans derive ecosystem services and benefits. It's a form of capital because it underpins economic and social systems.*	*Natural Capital Coalition (2016); TEEB (2010); World Bank (2018)*
Natural Capital Accounting (NCA)	*A structured framework for integrating environmental and economic data to measure stocks and flows of natural capital and their contribution to the economy.*	*United Nations, 2021; World Bank, 2023*
Nature based solutions (NbS)	*Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits.*	*UNEA 5.2 (2022)*
Ecosystem Services (ES)	*The contributions of ecosystems to the benefits that are used in economic and other human activity.*	*United Nations. (2021).*
Ecosystem Service Valuation (ESV)	*The process of assigning economic value to ecosystem services to make their benefits visible in decision-making, using market and non-market valuation methods.*	*Costanza et al. (2014); TEEB (2010)*
Dependencies (on Nature)	*Dependencies are aspects of environmental assets and ecosystem services that a person or an organization relies on to function. A company's business model, for example, may be dependent on the ecosystem services of water flow, water quality regulation and the*	*Taskforce on Nature-related Financial Disclosures [TNFD] (2023)*

	regulation of hazards like fires and floods; provision of suitable habitat for pollinators, who in turn provide a service directly to economies; and carbon sequestration	
Impacts (on Nature)	*Changes in the state of nature (quality or quantity), which may result in changes to the capacity of nature to provide social and economic functions. Impacts can be positive or negative. They can be the result of an organization's or another party's actions and can be direct, indirect or cumulative. A single impact driver may be associated with multiple impacts.*	*TNFD (2025)*
Materiality (Environmental /Nature-related)	*The significance of an environmental issue in influencing business value or ecosystem health. "Double materiality" includes both financial and environmental importance.*	*European Commission (2022); TNFD (2023)*
Stocks (of Natural Capital)	*The total amount of natural resources (e.g., forests, minerals, water) available at a given time, providing the base for future flows of services.*	*United Nations (2021); World Bank (2018)*
Flows (of Ecosystem Services)	*The ongoing benefits or services derived from natural capital stocks, such as water purification, carbon sequestration, or soil formation.*	*United Nations (2021); TEEB (2010)*
Pressures	*The use of a measurable quantity of a natural resource or release of measurable quantity of substances, physical and biological agents*	*ENCORE Knowledge base, (2025)*

List of Acronyms

API - *Application Programming Interfaces*
AUM - *Assets Under Management*
BIPOC - *Black, Indigenous, and People of Color*
CC BY-NC-SA - *Creative Commons Non-Commercial Attribution-ShareAlike*
CC BY-SA 4.0 - *Creative Commons Attribution-ShareAlike 4.0 International*
CDP - *Carbon Disclosure Project*
COP - *Conference of the Parties*
CSRD - *EU Corporate Sustainability Reporting Directive*
EBITDA - *Earnings Before Interest, Taxes, Depreciation, and Amortization*
ENCORE - *Exploring Natural Capital Opportunities, Risks and Exposure*
ES - *Ecosystem Services*
ESP - *Ecosystem Services Partnership*
ESR - *Environmental and Social Risk*
ESV - *Ecosystem Services Valuation*
ESVaR - *Ecosystem Services Value at Risk*
ESVD - *Ecosystem Services Valuation Database*
FSD - *Foundation for Sustainable Development*
GDP - *Gross Domestic Product*
IBAT - *Integrated Biodiversity Assessment Tool*
INCA - *Integrated Natural Capital Accounting*
ISSB - *International Sustainability Standards Board*
JRC - *European Commission's Joint Research Centre*
KBA - *Key Biodiversity Areas*
KIA LWV - *Knowledge and Innovation Agenda for Agriculture, Water and Food*
LVVN - *Dutch Ministry of Agriculture, Fisheries, Food safety and Nature*
NbS - *Nature-based Solutions*
NC - *Natural Capital*
NPI - *Nature Positive Initiative*
OMFIF - *Official Monetary and Financial Institutions Forum*
PBAF - *Partnership for Biodiversity Accounting Financials*
PBL - *Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving)*
ROI - *Return on investment*
RVO - *Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland)*
SANBI - *South African National Biodiversity Institute*
SBTi - *Science Based Targets Initiative*
SEEA - *System of Environmental-Economic Accounting*
TNFD - *Taskforce on Nature-related Financial Disclosures*
UNEP FI - *United Nations Environment Programme Finance Initiative*
UNEP-WCMC - *United Nations Environment Programme World Conservation Monitoring Centre*
WOCAT - *World Overview of Conservation Approaches and Technologies*
WRI - *World Resources Institute*

1. Introduction

Scoping the potential

In recent years, the landscape of nature-related data and decision-support tools has expanded rapidly. Governments, financial institutions, and businesses are increasingly seeking credible, transparent, and interoperable information to understand how economic activities depend on nature, how they impact ecosystems, and how these relationships shape risks and opportunities. This growing demand has stimulated the development of large environmental datasets and platforms, including the Ecosystem Services Valuation Database (ESVD) and Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE). Each tool has evolved to serve specific user communities and policy needs, and together they reflect a broader shift toward increasingly standardised and scalable approaches for assessing the role of nature in economies and societies.

As these platforms mature, an important next step for the wider nature-data ecosystem is to explore how large datasets can be meaningfully connected in ways that strengthen their decision-relevance without compromising their integrity, purpose, or governance. This is especially relevant in a context where users are increasingly expected to meet complex regulatory and reporting requirements, such as the Corporate Sustainability Reporting Directive (CSRD), the Taskforce on Nature-related Financial Disclosures (TNFD), and the evolving International Sustainability Standards Board (ISSB) guidance, which require consistent, transparent, and empirically grounded information on nature-related dependencies, impacts, and socio-economic consequences.

The ESVD, hosted by the Foundation for Sustainable Development (FSD), contains over 12,000 standardized monetary estimates of ecosystem services from more than 1,400 peer-reviewed studies, providing one of the most comprehensive, open-source, global datasets containing economic evidence on the value of nature. Its purpose is to make ecosystem service values visible and accessible, enabling users to understand the socio-economic importance of ecosystems and their services in a comparable and consistent way.

ENCORE – developed by Global Canopy, UNEP FI and UNEP-WCMC – offers a complementary perspective by identifying the extent to which economic sectors depend on and exert pressures on nature. It is widely used by financial institutions as a screening and prioritisation tool to identify where environmental risks are likely to arise. ENCORE provides qualitative dependency and impact materiality assessments grounded in established environmental-economic classifications and supported by an open-access data structure.

Both tools therefore contribute distinct but complementary insights: ESVD provides monetary values of ecosystem services, for various beneficiaries, delivered by different ecosystem types across different global locations, while ENCORE presents sector-nature relationships

in a way that supports early-stage risk screening and prioritisation. As sustainability reporting frameworks increasingly require organisations to articulate both financial and societal dimensions of nature-related materiality, there is growing interest in whether and how these two types of information might be used together.

This scoping report was initiated by FSD to explore, in an open and non-prescriptive manner, the feasibility and value of creating meaningful connections between ESVD's valuation data and ENCORE's dependency and pressure structure. The ENCORE Partners have contributed insights to this exploration. The purpose of this report is to identify whether potential complementarities exist, what technical and conceptual steps would be required to test them, and what limitations and uncertainties would need to be addressed in any subsequent discussion.

This exploration builds on the significant progress that both tools have made in recent years and responds to a shared recognition across stakeholders that nature-related decisions increasingly require multiple forms of evidence: scientific, spatial, economic, and sectoral. Connecting large environmental datasets in a meaningful way is inherently challenging. Differences in scale, purpose, methodology, and licensing must be acknowledged from the outset. At the same time, early stakeholder consultations conducted for this scoping study indicate interest in understanding how qualitative assessments of dependencies and pressures might, under specific conditions, be complemented by quantitative, location-specific economic evidence to support extended double materiality assessments and other emerging user needs.

The following sections build on this motivation by outlining 1) the potential areas where ESVD and ENCORE information could conceptually intersect, 2) the technical considerations involved in exploring such connections, and 3) the practical questions that would require further discussion before any future development could be considered. In doing so, the report aims to facilitate a broader dialogue on how large environmental datasets can evolve to meet the growing demand for decision-ready information in a rapidly changing regulatory and policy landscape, while remaining grounded in scientific credibility, transparency, and respect for the roles and mandates of each contributing platform.

2. Scoping

The assignment and methodology

The Dutch Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN) commissioned this scoping study to explore whether and how data from the ESVD and ENCORE could be combined in a meaningful way. The purpose of the assignment was to assess conceptual and technical feasibility, rather than to develop an integrated product or propose any direction for the tools themselves.

The central question guiding this scoping exercise was how the distinct types of information offered by each tool, ENCORE's dependency and pressure assessments and ESVD's monetary valuations of ecosystem services, could complement one another. The study sought to understand what a meaningful connection between these datasets might look like from a technical perspective, while fully acknowledging the limitations, uncertainties, and early stage of this exploration.

To address the assignment, the project followed a structured methodology comprising several key activities. First, interviews and consultation rounds were conducted with a range of stakeholders from financial institutions, policy bodies, research groups, and data providers. These discussions helped identify potential use cases where complementary insights from ESVD and ENCORE could conceptually add value, as well as challenges and user requirements that would need to be considered.

Second, the study included an initial mapping of each tool's strategic direction to identify potential areas of synergy, including consultations with governance partners such as Global Canopy, UNEP FI, UNEP-WCMC for ENCORE, and Brander Environmental Economics for ESVD. This exploration helped clarify where the tools' current pathways may align or diverge, while recognising that strategic decisions and governance discussions fall outside the scope of this report.

Third, drawing on the insights from stakeholders, the team developed three preliminary draft outputs illustrating how ESVD and ENCORE data could conceptually be combined. These examples are intended purely as illustrative prototypes to support discussion; they do not imply tool development or design intentions. Suggestions were also made on how such outputs could be structured or visualised in principle.

Fourth, the study assessed the compatibility of the two data sources from a licensing and intellectual property perspective, reviewing open-data licences and exploring attribution requirements. This was complemented by an exploration of potential methodological workflows that could, in theory, support the production of combined outputs. As noted previously, this does not commit any organisation to developing any operational solutions at this stage.

Finally, a set of research questions was identified to guide a potential next phase of work should stakeholders decide further exploration is warranted. Relevant experts were consulted at multiple points throughout the process to ensure that the technical considerations remain credible and the limitations and uncertainties of this early scoping stage were clearly acknowledged.

To maintain clarity, neutrality, and suitability for a broad audience, the findings from strategic, governance, and licensing discussions have not been included in this public-facing report. Instead, the sections that follow focus exclusively on the conceptual and technical dimensions of the scoping assignment, outlining where complementarities may exist and what challenges or methodological questions would need to be addressed before any next steps could be considered.

3. Use cases

What would integration look like?

As part of this project, three preliminary use cases have been developed, based on expert consultations and interviews with potential users, to demonstrate how combining ENCORE's dependency and pressure materiality ratings with ESVD's monetary values of Ecosystem Services can address distinct user needs and decision contexts. The use cases will be named as follows throughout the report:

1. Compliance disclosure
2. Portfolio screening
3. Project due diligence

All use cases centre around the conceptualisation of extended double materiality. Adding a socio-economic perspective through ecosystem service valuation strengthens the double materiality analysis of a company by connecting corporate dependencies and impacts to the broader landscape of communities, sectors, and value chains that share the same natural assets. While traditional double materiality captures the direct relationship between a company and nature, it often overlooks how changes in ecosystem services reverberate through local economies, affecting employment, food production, public health, and regional infrastructure. When applying the TNFD's LEAP approach, corporations are encouraged to define the consequences and relative significance of dependencies and impacts on nature (for both business and/or society) (TNFD, 2023). ESVD quantifies nature's value in economic terms, primarily capturing societal value which can be used, when combined with ENCORE's sectoral dependency framework, to support context-specific screening of dependencies, impacts, and potential socio-economic consequences in a given area, both within and beyond their own operations.

The three use cases developed in this chapter draw on five core opportunities identified throughout the scoping process: #1 monetised materiality ratings, #2 spatially explicit materiality maps, #3 sector-level dependency footprints, #4 dashboard-enabled portfolio analysis, and #5 framework-aligned reporting outputs.

This section provides systematic overviews of the use cases. Listing purpose, target audience, key features and example outputs. The various images of potential platform functionality are for illustrative purposes only. As noted previously, dissemination mechanisms for eventual combined outputs would need to be decided in a future phase of work in line with strategic and governance directions as well as user needs. Additional work on methodological feasibility and scientific robustness would also be needed before the creation of these outputs to ensure that they are fit for purpose and do not risk leading to negative unintended consequences. Examples of identified research questions are outlined in Section 3.4 Research Questions Emerging from the Use Cases.

More comprehensive information on the use cases can be found in Annex 1.

3.1 Use case - Compliance disclosure

Purpose

Support companies in meeting mandatory (CSRD) and voluntary (TNFD; potentially ISSB in future) nature-related disclosure requirements by quantifying ecosystem service dependencies and impacts in monetary terms for (extended) double materiality assessments.

Target Audience

- **Primary:** Large corporations subject to CSRD (50,000+ EU companies by 2028).
- **Secondary:** Companies adopting the TNFD framework (733+ organizations, USD 22 trillion AUM).
- **Tertiary:** Sustainability consultants and reporting service providers.

Key Features

- **Integrated Workflow:** Single assessment that could feed both CSRD and TNFD requirements.
- **Monetized Materiality Screening:** ENCORE ratings would be weighted and multiplied by ESVD values.
- **ESVaR Calculation:** Annual ecosystem service value at risk (ESVaR) quantification.
- **Confidence Transparency:** Study count, geographic match, recency indicators.
- **One-Click Exports:** Auto-generated CSRD/TNFD-compliant disclosures (.xlsx format).
- **Annual Update Automation:** Alerts for new ESVD studies, version control.

Rationale

This use case is primarily linked to Opportunity #5 (Framework-Aligned Reporting Outputs) and would directly address emerging disclosure requirements. It also covers Opportunity #1 (Monetised Materiality Ratings) and Opportunity #2 (Spatially Explicit Materiality Maps) by providing Ecosystem Services Value at Risk (ESVaR) calculations and geographic visualizations, which could show where dependencies are most financially significant for both business operations and local stakeholders.

Example Output: Monetized Materiality Screening

Would assign numeric weights to ENCORE materiality ratings (e.g., High = 0.8) and multiply by ESVD monetary values (ha/year) to differentiate between sites with identical dependency ratings. For example: Site A and Site B both show High water dependency (0.8). Adding ESVD values could reveal Site A at 0.8 × $2,000/ha/year = 1,600 versus Site B at 0.8 × $500/ha/year = 400—identifying Site A as a priority for deeper assessment.

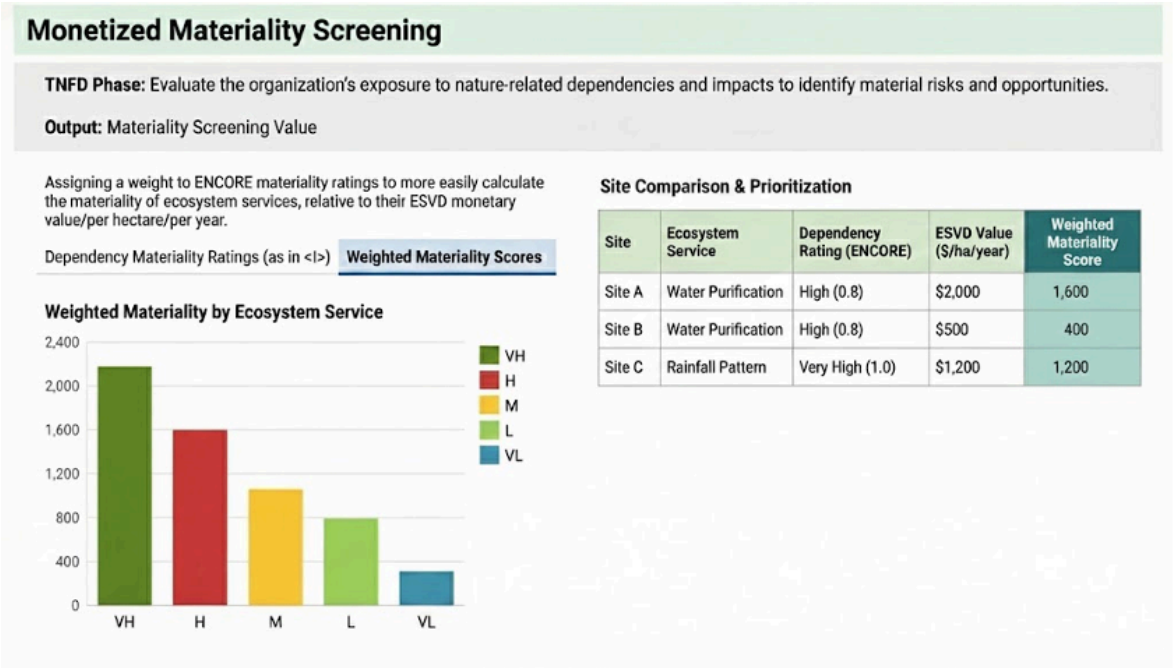

Figure 2. *Potential visualization of the output for Monetized Materiality Screening generated by AI for illustrative purposes only.*

This screening metric does not quantify biophysical dependency, ecosystem scarcity, or financial loss. It provides an initial prioritisation signal. ES values reflect prevailing supply–demand dynamics and beneficiary context and should therefore not be interpreted as conservation priority, equity weighting, or unsustainable use.

Pros: Streamlines compliance with multiple frameworks simultaneously, provides quantitative data to complement qualitative materiality thresholds.

Cons: ESVD values represent societal value, requiring additional interpretation for financial materiality, data gaps in certain regions may require value transfer functions.

3.2 Use case - Portfolio Screening

Purpose

Enable portfolio managers to transform ENCORE's qualitative sector materiality ratings into actionable financial risk metrics for systematic screening of credit and investment portfolios, quantifying monetary exposure to nature-related risks and prioritizing holdings requiring immediate engagement or divestment considerations.

Target Audience

- **Primary:** Asset managers and portfolio managers.
- **Secondary:** Credit risk teams at financial institutions.
- **Tertiary:** Institutional investors requiring nature risk reporting from asset managers; and ESG analysts and sustainability teams.

Key Features

- **ESVaR Calculation:** Converts ENCORE ratings to numeric weights and multiplies by ESVD values for monetary exposure. ESVaR is an indicative screening metric that reflects dependency-weighted societal ecosystem service value under current conditions; it does not represent a modeled financial loss, ecosystem scarcity, or unsustainable use signal.
- **Composite Risk Scoring (0-100):** Combines ESVaR with investment size and location sensitivity for prioritization.
- **Portfolio Heat Maps:** Visual breakdown by sector, geography, and ecosystem service exposure.
- **"Where to Start" Algorithm:** Auto-prioritizes holdings requiring immediate action.
- **Red Flag Alerts:** Triggers when holdings exceed pre-defined thresholds.
- **Sector Peer Benchmarking:** Compares holdings against sector medians/percentiles.
- **One-Click Exports**: Excel reports with company-specific data and calculations.

Rationale

This use case is primarily linked to Opportunity #3 (Sector-Level Dependency Footprints) by summarizing total annual ecosystem service value upon which portfolios depend.

It also supports Opportunity #4 (Nature Risk Explorer/Dashboard) and Opportunity #2 (Spatially Explicit Materiality Maps) by providing heat maps and geographic concentration

analysis showing where dependencies are most financially significant, helping interpret risks within a broader socio-ecological context.

Example Output: Risk Score & Priority Ranking

Generates a prioritized list of holdings with composite risk scores (0-100) combining dependency materiality, monetary exposure (ESVaR), position size, and location sensitivity. For example, a Chinese manufacturing facility scores 92/100 due to high water dependency ($85.4M ESVaR) in a water-scarce location, triggering "immediate engagement" recommendation.

Rank	Holding	Sector	Country	Composite Risk Score 0-100	Annual ESVaR ($m/yr)	% of Portfolio ESVaR	Confidence	Recommended Action	Primary Driver of risk
1	K	Manufacturing	China	92	85.4	6.80%	High	Immediate engagement	High dependency on water supply; large position in water scarce location
2	B	Agriculture	China	88	63.1	5.00%	Low	Commission assessment	Sparse local valuation evidence; potential hotspot basin
3	C	Mining	Zambia	81	47.6	3.90%	Med	Immediate engagement	Multiple high intensity pressures; mid-large position size
4	L	Textiles	India	77	28.9	2.30%	Med	Quarterly monitoring	Ecosystem service exposure diversified but elevated vs sector peers

Table 2. *Potential visualization of the Risk Score & Priority Ranking*

Pros: Enables rapid, portfolio-wide prioritisation by combining sectoral dependency signals with location-specific socio-economic context.
Translates qualitative dependency assessments into a transparent, comparable screening metric to guide engagement and further analysis.
Supports explainable, auditable portfolio triage without requiring company-specific performance data at early stages.

Cons:

- ESVaR represents societal ecosystem service value potentially affected under current conditions; it is not a probability-weighted financial loss or measure of ecosystem scarcity.
- Dependency-weighted screening does not account for ecosystem condition, supply constraints, or company-specific mitigation measures.
- Results are sensitive to geographic resolution and data availability and should be interpreted as indicative rather than predictive.

A detailed explanation of the interpretation, intended use, and limitations of the Ecosystem Services Value at Risk (ESVaR) metric is provided in Annex 1 (Use case 2 – Portfolio Screening).

3.3 Use case - Project Due Diligence

Purpose

Provide site-specific investment screening support for development banks and project finance teams to assess projects in data-poor regions, quantifying baseline ecosystem service values, identifying credit risks in sensitive geographies, and comparing nature-based versus engineered alternatives for approve/condition/defer decisions.

Target Audience

- **Primary:** Development banks (especially those operating in Africa, Latin America based on known data gaps).
- **Secondary:** Impact investors and project finance teams.
- **Tertiary:** Environmental and Social Risk (ESR) assessment teams.

Key Features

- **Site Screening:** Maps activities to pressures and ecosystem dependencies.
- **Site ESVaR:** Monetary estimate of ecosystem services at project location. Site ESVaR is an indicative screening signal reflecting societal ecosystem service value potentially affected within a project's area of influence; it is not a modeled impact forecast or financial loss estimate.
- **Borrower Credit Flags:** Frames ESVaR as alternative sourcing costs.
- **Spatially Explicit Materiality Maps:** Identifies hotspots near project footprint.
- **Alternatives Comparison:** Side-by-side analysis of nature-based vs engineered options.
- **Confidence Indicators:** Flags data gaps requiring additional research.
- **Decision Memo Pack:** One-click PDF/Excel exports with recommendations.

Rationale

This use case is primarily linked to Opportunity #2 (Spatially Explicit Materiality Maps), showing location-specific assessments of where ecosystem service values to communities and sectors are highest. It also supports Opportunity #1 (Monetised Materiality Ratings); and Opportunity #5 (Framework-Aligned Reporting) by quantifying nature-based infrastructure benefits and co-benefits.

Example Output: Site Screening & Exposure Profile

Quantifies site-level monetary exposure showing annual ESVaR for project footprint, key ecosystem services dependencies with ENCORE ratings and ESVD values, environmental pressures generated, and confidence signals.

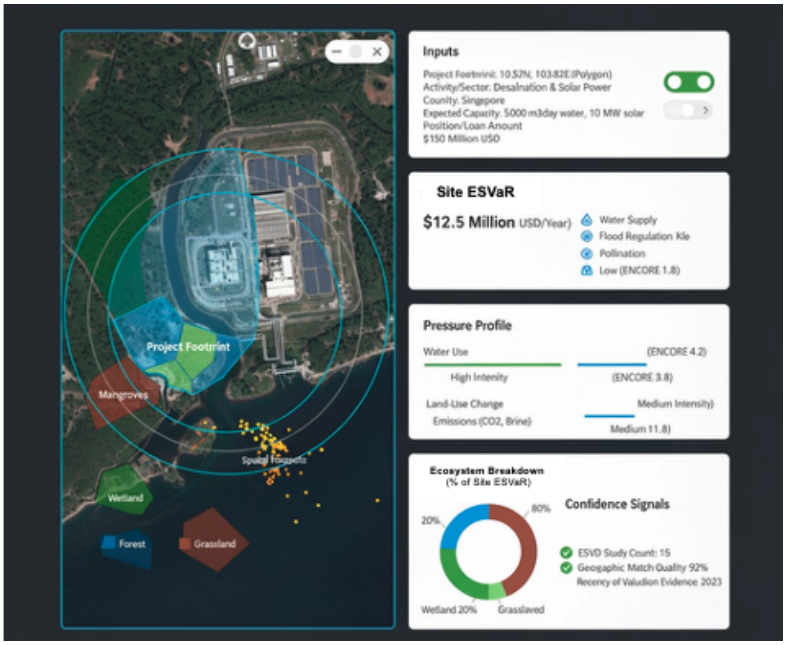

***Figure 10**. Potential visualization generated through Google's Gemini 2.5 Flash for illustrative purposes only*

In this use case, Ecosystem Services Value at Risk (ESVaR) is used as an indicative screening metric to highlight ecosystem service values that could potentially be affected within a project's area of influence. It represents societal ecosystem service value under current conditions and does not model ecological change, cumulative impacts, or probability-weighted financial loss. The metric is intended to support early-stage prioritisation and scoping, not to replace Environmental Impact Assessments or project-specific ecological studies.

Pros: The ESVD data help provide monetary baselines for projects in data-poor regions, identifying where deeper due diligence is needed.

Cons: Does not substitute for comprehensive Environmental Impact Assessments, may oversimplify complex local stakeholder dynamics, restoration cost comparisons may not capture full ecological complexity in comparison to engineered solutions.

3.4 Research Questions Emerging from the Use Cases

The three use cases developed in this scoping study highlight interest for combined ENCORE–ESVD outputs but also reveal several conceptual and methodological gaps that would need to be addressed if relevant parties would consider a follow-up phase. These research questions are specific to making the use cases functional and translate directly from user needs expressed during consultations.

1. How can ESVD values be made decision-ready for double materiality assessments?

- What subset of ESVD values would be most appropriate for *dependency* analysis versus *impact* analysis?
- How could ESVD's societal value estimates be coupled with ENCORE's corporate dependency ratings, without implying direct monetary flows to companies?
- How can uncertainty (e.g., data gaps, transfer quality, spatial mismatch) be transparently communicated in compliance workflows?

2. How to ensure geographic relevance in practice?

- What minimum spatial resolution is needed for different applications such as disclosure, screening, and due diligence applications?
- How should ESVD values be matched to site-specific geographies using consistent and auditable methods, and at what scales of analysis?

3. How to operationalise ES Value at Risk (ESVaR) responsibly?

- What methodological boundaries are required to prevent misinterpretation of ESVaR as direct financial loss?
- What confidence levels on ecosystem service value estimates are appropriate for different user contexts (e.g., CSRD screening vs. project finance)?

Answering these questions would support the transition from conceptual use cases to practical design. They would need to be addressed before any fully operational workflow or tool can be developed. Findings from the upcoming IPBES Business & Biodiversity Assessment will likely inform this next step, especially regarding the conceptual understanding of business impacts and dependencies and the methods for assessment.

4. Technical conceptual design

How to build the connection

The objective of this chapter is to define technical options and requirements that would be needed for a connection between ESVD and ENCORE in a way that is user-friendly, scalable, and flexible. Building on insights from expert consultations, interviews with potential users and described use cases, it aims to provide an initial outline of the methodological steps required for integrating ESVD and ENCORE data.

4.1 Methodological Workflows

If there is demand and support for the proposed use cases in the previous section that integrate ESVD and ENCORE data, the methodological workflows would need to be considered. Each sub-section builds on the previous one without duplicating the workflow. For example, the Core Data Integration workflows, while applicable to all three potential outputs, are only mentioned once. Workflows outlined in the Compliance Disclosure use case, if also applicable to the Portfolio Screening use case and/or the Project Due Diligence use case, are described only once, and so on.

Core Data Integration Framework

Ecosystem service classification mapping

- Conduct systematic mapping of the ecosystem service classifications used in the ESVD (TEEB, CICES 5.1, SEEA EA) to ENCORE's ecosystem service classification, in addition to relevant disclosure frameworks (e.g. CSRD, 2022, TNFD, 2023), which may use alternative ecosystem services and ecosystem classifications.
- Identify one-to-many and many-to-one relationships (e.g., ENCORE's Biomass Provisioning data to ESVD's "timber", "fish" "plants/ vegetable food" etc.).

Output: Crosswalk table mapping ESVD's ecosystem services schema to ENCORE's ecosystem services schema.

Ecosystem type classification

- Standardize ecosystem typology (terrestrial/freshwater/coastal/marine) to relevant global spatial data layers (e.g. the hotspots of natural capital depletion layers displayed in ENCORE) for consistent overlays and hotspotting. Where a better source of spatial data is available, consider using it in place of the data featured on the ENCORE website.

Output: Crosswalk table mapping ESVD ecosystems to ENCORE ecosystem components (i.e., atmosphere, biodiversity, soils and sediments, and water) and relevant spatial data.

Geospatial identification of available value data

- Extract location data from all ESVD studies (country, region, coordinates if available, ecosystem type).
- Where studies lack precise coordinates, assign to the closest identifiable location unit.
- Develop proximity algorithm e.g.
    - **Exact match** (100%): Same country + same ecosystem type
    - **High match** (75-99%): Adjacent country + same ecosystem
    - **Medium match** (50-74%): Same region + same ecosystem type
    - **Low match** (25-49%): Same region OR same ecosystem type (but not both)
    - **Poor match** (<25%): Different region and ecosystem type
- Provide aggregate Minimum, Median (or Mean) and Maximum ESVD values per hectare per year by Ecosystem, Ecosystem Service and Location (Country, Global, Region [i.e. Europe, Sub-Saharan Africa, etc.]).

Outputs:

- Geospatial matching algorithm that returns ESVD values ranked by location relevance for any given asset/project coordinate.
- Confidence rating for geospatial relevance and aggregated values by ecosystem service, ecosystem type, and location for comparison.

Citation and traceability

- Every monetary value must link to underlying data, including metadata fields:
    - ESVD study ID(s)
    - Publication citation (author, year, title, journal/report)
    - Geographic coordinates of original study
    - Ecosystem type and services valued
    - Valuation method used and identified beneficiaries
    - Original currency and year (in addition to standardized value)
    - Transfer adjustments applied (if any)
    - Value must be externally reviewed

Output: Excel outputs including "Citations" column with hyperlinks to studies, and PDF or Word document including a bibliography.

Ecosystem service dependency value ranges

- Provide aggregate global/sectoral/sector-level. Minimum, median (or mean) and maximum ESVD values for each ecosystem service and ENCORE materiality rating.

Output: Sector-specific ecosystem service materiality ratings mapped to minimum, median (or mean), maximum monetary values per hectare per year (by location and ecosystem type).

Value transfer function development

In a potential ENCORE–ESVD connection, value transfer functions would serve as a necessary enabling mechanism where ENCORE's dependency and pressure screening identifies material risks in locations or ecosystem services for which ESVD currently lacks primary valuation evidence.

- For each ecosystem service for which there is sufficient data, conduct a meta-regression analyzing how values vary with key explanatory variables (e.g. GDP per capita, population density, ecosystem condition/intactness and relevant external data from ENCORE map data layers or other suitable sources of spatial data).
- Test the predictive performance of the estimated value transfer functions to assign confidence ratings.

Output: Value transfer function library with confidence ratings and guidance on implementation.

Confidence ratings for transferred values

- Confidence scoring for monetary values for an ecosystem service based on the study count, geo match, recency, and other defined variables.
- Confidence scoring for monetary values estimated using value transfer functions based on tested out-of-sample predictions.

Output: Five-star confidence level rating for transferred values with definitions and recommendations.

Required confidence level for user application

- Define required confidence level for user applications to determine when a value transfer is acceptable versus when primary research is needed e.g.
    - **Transfer acceptable**: Use of information is for routine screening, preliminary assessments.
    - **Primary study needed**: High-stakes decisions (>$XM exposure).

Output: Five-star confidence level rating required by the user application.

Reporting & Disclosure

Weighted Materiality Calculation

- Assign weights to ENCORE materiality ratings e.g. Very High=1.0, High=0.8, Medium=0.6, Low=0.4, Very Low=0.2
- Script development to compute weighted materiality based on materiality rating x median ecosystem service value.

Output: Ecosystem service materiality ratings shown in standard format and weighted materiality taking into account the monetary value of each ecosystem service.

Reporting Frameworks Mapping

- Mapping of all platform data outputs to the relevant TNFD (2023), CSRD (2022) and other framework indicators.

Output: One-click export in .xlsx format (data) and PDF format for maps, charts and relevant visualizations.

Ecosystem Services Value at Risk (ESVaR) geospatial data layer and co-benefits quantification

- Identification of all ecosystems, area in hectares and ecosystem services within an operational footprint and area of influence.
- For each ecosystem service, multiply the estimated unit value by ecosystem area (hectares) to get total annual value.
- Calculate the total sum of all ecosystem services for an annual estimated value of ESVaR.
- Classify and standardize ESVD data by beneficiary group (e.g. smallholder farmers, urban populations, residents, utility providers, businesses) and potentially relevant ISIC economic activities (e.g. tour operator activities).
- Cross-reference with ESVD beneficiary group data to estimate and categorize ESVaR for business and society.
- Potentially highlight intersection with Key Biodiversity Areas (KBAs), Ramsar wetlands, UNESCO World Heritage sites, Indigenous territories, and resource-driven conflict areas.
- Integrate a geospatial data layer on conflict zones and/or climate vulnerability and assign 5 or 10-point risk scale to flag high-risk implications of lost ESVaR.
- Provide a simple ‘ESVaR as a percentage of corporate revenue’ calculator.

Output: Additional data layers and an ESVaR calculator that contextualise the ecosystem service value potentially exposed within a project's footprint or area of influence, differentiated by business relevance, societal beneficiaries, and geographic sensitivity..

Additional Output: For NbS, quantification and comparison with engineered solutions, user must input primary ecosystem service (e.g. Flood protection), ecosystem (e.g. mangroves) and project lifetime (e.g. 20 years) to receive the value of the primary ecosystem service, and the additional ecosystem services value–the co-benefits–over the project lifetime, for comparison with an engineered solution (e.g. storm wall).

Portfolio Screening

Ecosystem Services Value at Risk (ESVaR) calculation

- In addition to the previous ESVaR workflow, it may be possible to explore handling batch processing of ESVaR for multiple holdings across a portfolio and aggregate them for analysis of Total Portfolio ESVaR and each holding's percentage contribution to Total Portfolio ESVaR.

Composite risk exposure scoring

- Composite prioritisation scoring aggregates ecosystem service dependency, pressure intensity, monetary value exposure, and geographic concentration to identify holdings with elevated nature-related exposure that warrant deeper sustainability and risk analysis. At this scoping stage, the composite score is designed to support exposure-based prioritisation rather than to assess the ecological sustainability or likelihood of ecosystem service decline, which would require additional condition, trend, and pressure-response data beyond the current scope.

Output: Geospatial map showing hotspots and risk exposure clusters, along with an exportable data dashboard showing concentration of risk exposure by sector, ecosystem service, and place.

Composite score calculation

- Risk score methodology, variables, weighting, standardization and calculation would need to be defined and normalized to a 1-100 scale.
- Confidence-adjusted recommendations would need to be defined based on the scores with present, threshold-based, recommended actions and justifications.

Output: Ranked holding list with risk score, confidence rating with justifications and recommended actions.

Project Due Diligence

Borrower credit risk and mitigation conditions

- Use ENCORE data to provide a first-layer screening that helps prioritise due diligence questions for further investigation for different investments based on the impact/dependency profile of the relevant economic activity.
- Overlay ESVaR with additional risk data layers such as water stress indices (World Resources Institute [WRI], 2023) and climate hazard exposure.
- Source or compile dataset on ecosystem restoration cost estimates (e.g. building on the World Overview of Conservation Approaches and Technologies (WOCAT) database).
- Apply meta-regression analysis to estimate restoration cost functions that explain variation in costs by variation in ecosystem characteristics and context (e.g. ecosystem type, site area, slope, climate, condition, restoration intervention) to enable prediction of restoration costs per hectare for project locations.
- Comparison of estimated restoration costs with predicted change in ecosystem service values to estimate ROI for restoration investments.
- Design a basic decision matrix indicating red flags, and when to commission targeted local valuation studies (when risk exposure is high and confidence is low).

4.2 Future Research Questions for Technical and Conceptual Design

Building on the use cases and methodological scoping, this section outlines ten broader research questions that go beyond immediate user needs and speak to the underlying science and data architecture required.

The questions are grouped into two subsets (Conceptual and methodological alignment, and Technical feasibility). Some extend beyond the scope of the ENCORE and ESVD teams and would require input from a wider consortium, including the Capitals Coalition Value Commission, JRC, ISSB, PBAF, PBL, and others. Similar to the note in section 3.4 regarding questions that emerged from the use case development, the upcoming IPBES Business & Biodiversity Assessment would be an important resource for prioritising and sequencing potential next steps.

Conceptual and Methodological Alignment

1. How can ESVD's ecosystem-service-level monetary values be mapped to ENCORE's sector-level dependency and pressure structure without losing context or interpretability? (Including one-to-many or many-to-one mappings between ES classifications.)

2. How should ESVD values be selected, filtered, or adapted to ensure comparability and appropriate use for: - corporate *dependencies*, - corporate *impacts*, and - *societal* well-being? (This incorporates concerns on coverage and comparability)

3. Under what conditions are value transfer functions appropriate, and how should confidence intervals, uncertainty bands, and applicability domains be defined and communicated?

4. How should ecosystem service valuation methods be mapped to decision types?
(e.g., avoided cost for risk, replacement cost for due diligence, co-benefits for NbS investment.)

5. What methodological and presentational safeguards are needed to ensure that ESVD values are not misinterpreted as direct corporate cash flows or revenues?

Technical Feasibility and Data Integration

6. What data architecture (API endpoints, modular data layers, cloud-based access, downloadable packages) best enables interoperability between ENCORE and ESVD?

7. What minimum spatial resolution and temporal resolution are required for different use cases? (e.g., site-level vs. basin vs. national vs. portfolio scale)

8. How can “area of influence” be defined and operationalised for automated geospatial screening?

9. What metadata, provenance, and versioning standards are needed to ensure transparency, auditability, and scientific credibility?

10. What technical mechanisms could address ESVD’s coverage gaps (value-transfer functions, predictive modelling, AI-assisted valuation)?

This scoping study highlights both the technical and methodological steps required for a potential ENCORE–ESVD connection, as well as the broader strategic context in which such an effort would have to be situated. As the nature-data ecosystem evolves, driven by developments in AI, digital twins, ESG reporting, and emerging data-sovereignty frameworks, environmental datasets, like ESVD and ENCORE, are expected to function as foundational digital infrastructure. Ensuring that connections like the one in this project remain aligned with emerging standards, and recognised as strategic assets, requires research and collaboration beyond the current project’s scope.

As such, while the conceptual opportunities outlined in this chapter are promising, substantial analytical, technical, and governance work remains ahead before any functional

connection could be developed or decided upon. The next chapters synthesise these insights (Chapter 5) and outline potential next steps (Chapter 6) for advancing this agenda in a responsible, phased, and collaborative manner.

5. Conclusions

This scoping study indicates that there is a conceptual, strategic, and stakeholder basis for a future connection between ESVD and ENCORE. Although no development decisions have been made, the findings point to an opportunity: bringing together sector-level assessments of nature dependencies and pressures with socio-economic evidence on the value of ecosystem services could help close one of the most persistent gaps in today's nature-related risk and disclosure landscape.

The stakeholder consultations show interest in approaches that move beyond high-level dependency ratings and towards geographically specific, decision-ready insights. Participants expressed that while existing tools help identify where and through which corporate activities nature-related risks may arise, they rarely show what is at stake for society or the broader socio-economic system when ecosystem services decline. This study therefore responds to an evolving need: nature-related assessments must increasingly connect corporate-level dependency and impact analyses with the wider socio-economic consequences that occur beyond the firm's boundaries. While current approaches largely focus on how a company depends on or affects nature, they often overlook how changes in ecosystem services affect communities, sectors, and regional economies. Strengthening the link between these corporate perspectives and their broader socio-economic implications is essential for understanding real exposure, risk, and resilience.

The combination of ENCORE's structured dependency and pressure framework with ESVD's monetary valuation data offers one possible pathway to address this gap. The three conceptual use cases developed – 1) compliance disclosure, 2) portfolio screening, and 3) project due diligence – illustrate how the two data sources could together support extended double materiality assessments, nature-related financial risk analysis, and evidence-based prioritisation. They also highlight an important shift in the wider data landscape: environmental datasets are emerging as strategic assets underpinning AI-based analytics, digital twins, sustainability dashboards, and future regulatory reporting systems. In such a context, the stewardship, interoperability, and scientific rigour of foundational datasets like ESVD and ENCORE will continue to be critical.

Technically, the study suggests that integration could be feasible, but only through careful methodological harmonisation and transparent uncertainty communication. It also underscores that substantial analytical groundwork is still required, including ecosystem service classification mapping, valuation method safeguards, geospatial matching protocols, and confidence scoring. These are complex tasks that extend beyond the remit of this scoping project and would require a phased research programme and engagement with a broader consortium of experts.

Strategically, the study points to a wider opportunity: as regulation (CSRD, TNFD), policy frameworks (KMGBF, EU Restoration Law), and market expectations converge, financial and policy actors increasingly need tools that bring ecological, economic, and societal evidence

together in a coherent and decision-relevant way. Exploring complementarities between ENCORE and ESVD goes beyond a technical exercise, it is part of a broader evolution in the nature-data ecosystem, where socio-economic perspectives are becoming integral to understanding nature-positive pathways and systemic risk.

In summary, this scoping study provides a foundation for informed decision-making on whether, when, and how deeper collaboration could be pursued. It highlights clear potential value, equally clear challenges, and a rapidly changing data landscape in which environmental datasets must be recognised, governed, and protected as strategic public goods. The next chapter (6. Suggested next steps) outlines how any future steps could be approached in a phased, responsible, and collaborative manner, should partners decide to take this agenda forward.

6. Next steps for nature data in risk management

The findings of this scoping study indicate that connecting ESVD and ENCORE has conceptual promise, initial user interest, and potential strategic relevance in an evolving nature-data landscape. At the same time, the study highlights that meaningful connection would require further clarity on methodological alignment, user value, governance, and licensing. The findings of this scoping project therefore serve as a foundation for informed decision-making, rather than a commitment to implementation. Open questions on the former two points cannot be resolved by the core partners alone, they require the involvement of a wider group of scientific, policy, and financial actors shaping the future of environmental data infrastructures.

Suggestion 1 — Convene a targeted roundtable to shape a shared strategic direction for the use of environmental data in nature risk assessment

The most immediate and high-potential next step is to organise a dedicated roundtable with key institutions—such as leadership of both ESVD and ENCORE, ESP working group leads, the Capitals Coalition Value Commission, JRC, PBL, PBAF, TNFD, ISSB, NatureTech Collective and selected financial and policy partners. With the aim to explore the broader question that emerged throughout this study: **How should environmental datasets evolve as strategic public-good assets in the emerging digital ecosystem of AI, disclosure, and nature-related risk assessment?**

Such a roundtable would:

- validate whether the conceptual opportunities identified in this scoping study align with wider strategic needs;
- establish where methodological and governance alignment is most needed;
- identify which organisations should participate in a potential consortium;
- clarify the landscape of funding, collaboration, and standardisation pathways (e.g., Horizon Europe, Digital Europe, or EU data-space architectures).

This step is feasible within the coming months and provides strong strategic leverage: it positions the partners at the centre of the evolving European nature-data agenda and ensures that any follow-up development is grounded in collective direction

.

Suggestion 2 — Develop a focused pilot concept only after a shared direction is reached

If the roundtable confirms interest in further exploration, the next step would be to define a small, tightly scoped pilot addressing one concrete use case (e.g., compliance disclosure or portfolio screening). Serving as an initial proof of concept. This pilot would:

- test data compatibility and methodological workflows on a limited set of ecosystem services, geographies, or sectors;
- explore how uncertainty, spatial relevance, and valuation confidence can be communicated transparently;
- validate user demand and interpretability through early testing with selected institutions.

A pilot is recommended only after strategic alignment is reached, ensuring resources are invested in a direction with broad support.

Suggestion 3 — Build toward a longer-term research and development programme

Depending on the outcomes of the roundtable and pilot, the partners may jointly explore the feasibility of a larger research programme, potentially under Horizon Europe or other multi-partner funding streams. Such a programme would focus on:

- methodological harmonisation (valuation, classification, spatial alignment);
- interoperability with emerging data spaces and AI-based analytical tools;
- development of strategic environmental datasets as digital public infrastructure.

The findings of this scoping study provide a strong foundation for next steps, but not yet a mandate for technical integration. The suggested path is to first build shared strategic direction through a targeted roundtable, followed by a small-scale pilot if appropriate, and only then consider a broader development programme. This phased, collaborative, and strategically grounded approach offers the needed value, feasibility, and credibility and can be initiated in the coming months.

7. References

Ascui, F., & Cojoianu, T. (2019). *Natural capital credit risk assessment in agricultural lending: An approach based on the Natural Capital Protocol*. Natural Capital Finance Alliance.

Bachmann, T. M. (2025). What is the difference between “environmental aspect,”“direct driver,” and “impact driver”?. *The International Journal of Life Cycle Assessment*, *30*(3), 401-404.

Brander, L. M., De Groot, R., Schägner, J. P., Guisado-Goñi, V., Van't Hoff, V., Solomonides, S., ... & Thomas, R. (2024). Economic values for ecosystem services: A global synthesis and way forward. *Ecosystem Services*, *66*, 101606.

Carbon Disclosure Project. (2023). *CDP Global Environmental Disclosure Report*. https://www.cdp.net

Cojoianu, T. F., Ascui, F., Clark, G. L., Hoepner, A. G. F., & Wójcik, D. (2015). *NCD scoping study: Towards including natural resource risks in cost of capital.* Oxford: Natural Capital Declaration.

Contreras del Valle, M. F. (2023). *Valuation of ecosystem services: A tool for decision-making in nature-based solutions projects* (Policy brief). EUROCLIMA+ Programme.

Convention on Biological Diversity. (2022). *Kunming–Montreal Global Biodiversity Framework*. https://www.cbd.int/gbf

Costanza, R., De Groot, R., Sutton, P., Van der Ploeg, S., Anderson, S. J., Kubiszewski, I., ... & Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global environmental change*, 26, 152-158.

Creative Commons. (n.d.). *Frequently Asked Questions — If I derive or adapt material offered under a Creative Commons license, which CC license(s) can I use?* Retrieved November 12, 2025, from https://creativecommons.org/faq/#if-i-derive-or-adapt-material-offered-under-a-creative-commons-license-which-cc-licenses-can-i-use

Daily, G.C. and Ruckelshaus, M. (2022) ‘25 years of valuing ecosystems in decision-making’, Nature, 606(7914), pp. 465–466. doi:10.1038/d41586-022-01480-x.

De Groot, R., Fisher, B., Christie, M., Aronson, J., Braat, L., Gowdy, J., ... & Shmelev, S. (2012). Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. In *The economics of ecosystems and biodiversity: Ecological and economic foundations* (pp. 9-40). Routledge.

ENCORE Partners (Global Canopy, UNEP FI, and UNEP-WCMC). ENCORE: Exploring Natural Capital Opportunities, Risks and Exposure. [On-line], September, 2025, Cambridge, UK: the ENCORE Partners. Available at: https://encorenature.org. DOI: https://doi.org/10.34892/dz3x-y059.

esvd.info. (2024). *Ecosystem Services Valuation Database: Foundation for Sustainable Development: Environmental Research*. Available at: https://www.esvd.info/ (Accessed: 27 June 2024).

esvd.net. (2025). *ESVD*. Available at: https://www.esvd.net/ (Accessed: 15 October 2025).

European Commission. (2018, updated 2022). *A sustainable bioeconomy for Europe: Strengthening the connection between economy, society and the environment* [EU Bioeconomy Strategy]. Publications Office of the European Union.

European Commission. (2019). *The European Green Deal*. Publications Office of the European Union. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

European Commission. (2020). *EU Taxonomy for sustainable activities*. Publications Office of the European Union.

European Commission. (2022). *Corporate sustainability reporting directive (CSRD).*

European Union. (2024). Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869. *Official Journal of the European Union*, *1991*, 1.

Folke, C. (1991). Socio-economic dependence on the life-supporting environment. In *Linking the natural environment and the economy: Essays from the Eco-Eco group* (pp. 77-94). Dordrecht: Springer Netherlands.

Ingram, J. C., McKenzie, E. J., Bagstad, K. J., Finisdore, J., van den Berg, R., Fenichel, E., ... & Spurgeon, J. (2024). Leveraging natural capital accounting to support businesses with nature-related risk assessments and disclosures. *Philosophical Transactions of the Royal Society B*, *379*(1903), 20220328.

International Capital Market Association (ICMA). (2021). *Green Bond Principles: Voluntary process guidelines for issuing green bonds. https://www.icmagroup.org*

International Sustainability Standards Board. (2023). *IFRS Sustainability Disclosure Standards*. IFRS Foundation. https://www.ifrs.org/issb

International Union for Conservation of Nature. *Nature-based solutions*. Retrieved September 11, 2025, from https://iucn.org/our-work/nature-based-solutions

La Notte, A., Marques, A., Petracco, M., Paracchini, M. L., Zurbaran-Nucci, M., Grammatikopoulou, I., & Tamborra, M. (2025). The assessment of nature-related risks: From ecosystem services vulnerability to economic exposure and financial disclosures. *Ecological Economics*, *235*, 108636.

Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis.* Island Press.

Natural Capital Coalition. (2016). *Natural capital protocol.*

Natural Capital Finance Alliance & PricewaterhouseCoopers. (2018). *Integrating natural capital in risk assessments: A step-by-step guide for banks*

Natural Capital Finance Alliance, & UN Environment World Conservation Monitoring Centre. (2018). *Exploring natural capital opportunities, risks and exposure: A practical guide for financial institutions*.

Nature Positive Initiative (NPI). (2023). *Nature Positive Initiative: Global goals for nature*. https://www.naturepositive.org

Netherlands Enterprise Agency. (2024). *Strengthening and valuing ecosystem services: Sub-programmes, impacts, and theory of change* (MMIP 1B). https://www.kia-landbouwwatervoedsel.nl/wp-content/uploads/MMIP-1B-en.pdf

Official Monetary and Financial Institutions Forum Sustainable Policy Initiative. (2022). *Translating biodiversity and nature risks into financial risks*. https://www.omfif.org

Partnership for Biodiversity Accounting Financials. (2024). *Impact on ecosystem services: A return on investment*. Partnership for Biodiversity Accounting Financials. https://pbafglobal.com/files/downloads/PBAF_fsdimpact_ecosystem_services_return_investment-july_2024.pdf

Science Based Targets initiative. (2023). *Science-based targets for nature and climate*. https://sciencebasedtargets.org

Stockholm Resilience Centre. (2016). *Planetary boundaries: Guiding human development on a changing planet*. Stockholm University. https://www.stockholmresilience.org

Taskforce on Nature-related Financial Disclosures. (2023). *Glossary*. Science Based Targets Network (SBTN) glossary of terms. https://tnfd.global/publication/glossary/

Taskforce on Nature-related Financial Disclosures. (2023). *TNFD final recommendations.*

Taskforce on Nature-related Financial Disclosures. (2025, January). *Glossary of key terms: Version 4.0* [PDF]. Taskforce on Nature-related Financial Disclosures. https://tnfd.global/wp-content/uploads/2023/09/TNFD-Glossary-of-terms-V4-June-2025.pdf?v=1753973343

The Economics of Ecosystems and Biodiversity. (2010). *Mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB.* UNEP.

UNEA 5.2 (2022). Resolution 5. Nature-based solutions for supporting sustainable development.

United Nations Environment Programme, United Nations Environment Programme Finance Initiative, & Global Canopy. (2020). *Beyond "business as usual": Biodiversity targets and finance. Managing biodiversity risks across business sectors* (42 pp.). UNEP-WCMC.

United Nations Environment Programme Finance Initiative. (2024). *Explanatory note on the updated ENCORE knowledge base outlining business dependencies and impacts on nature*. https://www.encorenature.org/resources/explanatory-note-on-the-updated-encore-knowledge-base-outlining-business-dependencies-and-impacts-on-nature

United Nations Environment Programme World Conservation Monitoring Centre. (2024). *Frequently asked questions on the updated ENCORE knowledge base*. https://www.encorenature.org/resources/frequently-asked-questions-on-the-updated-encore-knowledge-base

United Nations. (2021). *System of environmental-economic accounting—Ecosystem accounting (SEEA EA).*

United Nations, Department of Economic and Social Affairs, & United Nations Statistics Division. (2025, July 14). *The Sustainable Development Goals Report 2025*. https://unstats.un.org/sdgs/report/2025/

World Bank. (2018). *The changing wealth of nations 2018: Building a sustainable future.* World Bank Publications.

World Bank. (2023). *Wealth accounting and the valuation of ecosystem services (WAVES) partnership.*

World Economic Forum. (2020, January). Nature risk rising: Why the crisis engulfing nature matters for business and the economy. In *World economic forum and price waterhouse coopers*. World Economic Forum.

World Resources Institute (WRI). (2023). *Aqueduct: Water risk atlas*. https://www.wri.org/aqueduct

World Wide Fund for Nature. (2016). *Living Planet Report 2016: Risk and resilience in a new era*. WWF International.

Annex 1: Use cases

As part of this project, three preliminary use cases have been developed, based on expert consultations and interviews with potential users, to demonstrate how combining ENCORE's dependency and pressure materiality ratings with ESVD's monetary values of Ecosystem Services can address distinct user needs and decision contexts. These use cases—compliance disclosure, portfolio screening, and project due diligence—are accompanied by illustrative examples showing potential applications and visualizations for future tools supporting nature-related financial and sustainability decision-making.

This section includes various images of potential platform functionality for illustrative purposes only. As noted previously, dissemination mechanisms for eventual combined outputs would need to be decided in a future phase of work in line with strategic and governance directions as well as user needs.

Use case 1 - Compliance Disclosure

Purpose

Reporting and disclosure were the dominant themes mentioned in all interviews. The CSRD makes double materiality legally mandatory for large EU companies (phasing in 2024-2028) with penalties for non-compliance (CSRD, 2022). While the TNFD remains voluntary, its momentum is accelerating with 733 organizations now adopting the framework, representing USD 22 trillion in assets under management. Significantly, the International Sustainability Standards Board (ISSB) has announced it will develop nature-related disclosure standards drawing on TNFD recommendations, including relevant aspects of the LEAP approach, which will further expand mandatory nature-related reporting requirements. The combined addressable user market for compliance disclosure is predicted to exceed an estimated 50,000+ companies by 2028.

The purpose of this first use case is to **extend double materiality assessments by combining ENCORE dependency/pressure materiality ratings with ESVD monetary valuations via a transparent mapping** (ENCORE ratings each assigned numeric weights).

Adding a socio-economic perspective through ecosystem service valuation strengthens the double materiality analysis of a company by connecting corporate dependencies and impacts to the broader landscape of communities, sectors, and value chains that share the same natural assets. While traditional double materiality captures the direct relationship between a company and nature, it often overlooks how changes in ecosystem services reverberate through local economies, affecting employment, food production, public health, and regional infrastructure. When applying the TNFD's LEAP approach, corporations are encouraged to define the consequences and relative significance of dependencies and impacts on nature (for both business and/or society) (TNFD, 2023). ESVD quantifies nature's value in economic terms, primarily capturing societal value which directly supports impact

materiality assessments. By combining ENCORE's sectoral dependency framework with geographically specific ES valuation data, organisations can quantify how nature degradation in a given area translates into socio-economic costs and financial risks, both within and beyond their own operations.

While this approach does not directly measure company-specific performance, it provides a transparent, quantitative foundation for interpreting materiality ratings, developing disclosure metrics, and aligning with emerging reporting standards.

Key Features of the use case

- **Integrated Workflow:** Single assessment process feeds both CSRD (2022) and TNFD (2023) requirements, eliminating duplicate work.
- **Confidence Transparency:** Every metric shows ESVD study count, geographic match quality, recency and flags low-confidence areas needing primary research. For Value Transfer Functions, separate confidence indicators are provided based on the robustness of the transfer model.
- **Validated values:** Every monetary value is traceable to its original data source or publication, ensuring transparency and reproducibility. This refers to validation of data provenance.
- **One-Click Exports:** Auto-generated TNFD and/or CSRD-compliant disclosures in downloadable .xlsx format, with embedded calculations and pre-filled data citation columns for traceability.
- **Annual Update Automation:** System alerts users when new ESVD studies relevant to company locations are published; automatically refreshes dependency and impact values with version control, and tracks year-over-year changes to support "progress" narratives.

Examples of Outputs

The following are examples of outputs for TNFD reporting (TNFD, 2023), using images to show how ENCORE, ESVD data and additional functionality could be combined.

In all geospatial map components, there is an opportunity for the use case to include a Value Transfer Function to fill data gaps–particularly in contexts where valuation study data are sparse. This process enables the user to estimate the value of ecosystem services through the use of existing value study data and information from bio-physical and socio-economic parameters from other similar ecosystems and populations of beneficiaries.

Monetized Materiality Screening

- **TNFD Phase: Evaluate** the organization's exposure to nature-related dependencies and impacts to identify material risks and opportunities.
- **Output: Materiality Screening Value**
  Assigning a weight to ENCORE materiality ratings to more easily calculate the materiality of ecosystem services, relative to their ESVD monetary value/per hectare/per year. The monetised materiality screening is intended as an exploratory,

early-stage prioritisation tool. It does not measure biophysical ecosystem service supply, ecosystem degradation, or company-specific financial exposure. Rather, it combines ENCORE's qualitative dependency ratings with indicative ecosystem service values to highlight where corporate dependencies coincide with high socio-economic relevance of ecosystem services. The output is designed to support screening and scoping decisions, identifying locations that may merit deeper, site-specific analysis using additional ecological, social, or financial data.

- **Benefit to Business:** The weighted materiality score enables rapid screening across multiple sites by differentiating between locations that share the same ecosystem dependency rating. For example: Site A and Site B both show High water dependency (0.8). Adding ESVD values reveals Site A at 0.8 × $2,000/ha/year = 1,600 versus Site B at 0.8 × $500/ha/year = 400—identifying Site A as a priority for deeper assessment. The weighted score prioritizes where to focus limited assessment resources before proceeding to more resource-intensive analyses. It does not directly refer to business dependency value or financial exposure.
- **Benefit to Society:** The weighting helps prioritize the importance of the ecosystem services values for local communities and other stakeholders–especially when combined with ESVD data on beneficiary groups that typically benefit from this ecosystem service. Ecosystem service values are influenced by both the supply of services and the demand from beneficiaries, including population density and income levels. As such, higher values do not necessarily indicate greater scarcity, unsustainable use, or ecological vulnerability, nor do lower values imply lower importance. The screening output should therefore be interpreted as reflecting relative socio-economic significance under current conditions, and may be complemented by additional indicators related to ecosystem condition, scarcity, vulnerability, or equity considerations where relevant.

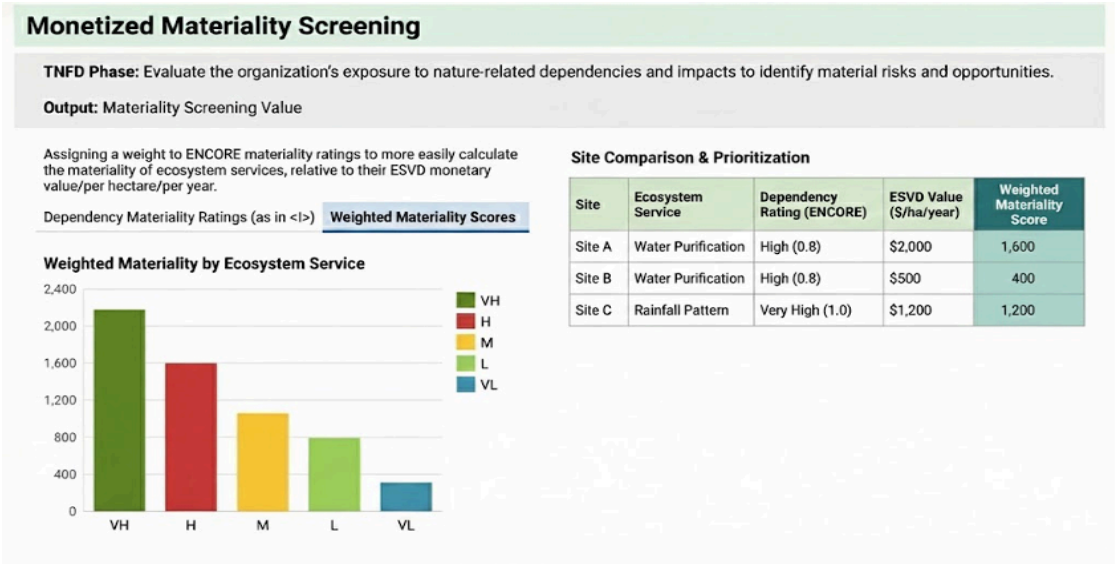

Figure 2. *Potential visualization of the output for Monetized Materiality Screening*

The illustrative example uses per-hectare annual values to demonstrate the logic of weighted screening. In practice, ecosystem services are generated and used across functional ecological units (e.g. river basins, landscapes, coastal systems), rather than isolated hectares. Defining the appropriate area of influence for attributing ecosystem service values to corporate activities is a key methodological question and would require further development before any operational application of this approach.

Ecosystem Service Value at Risk (ESVaR)

- **TNFD Phase: Assess** the risks and opportunities identified to understand their potential financial implications.

- **Output: Ecosystem Services Value at risk (ESVaR)**
  Sum of Median Ecosystem Services Value (derived from ESVD valuations, not a modeled loss).

- **Benefit to Business:** Quantify the total potential value of ecosystem services lost due to company impacts, whether or not the company benefits directly. Illustrate pressures magnitude, including context of vulnerable populations, conflict or complaint-afflicted areas, and other risks.

- **Benefit to Society:** Quantify the total potential value of ecosystem services lost due to company impacts, and the potential stakeholder groups negatively affected (can also be combined with ESVD data on ecosystem condition at the time of valuation for an indicator of value vs. intactness). Can answer questions like: Does affected stakeholder value exceed 10% of company Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA) equivalent?

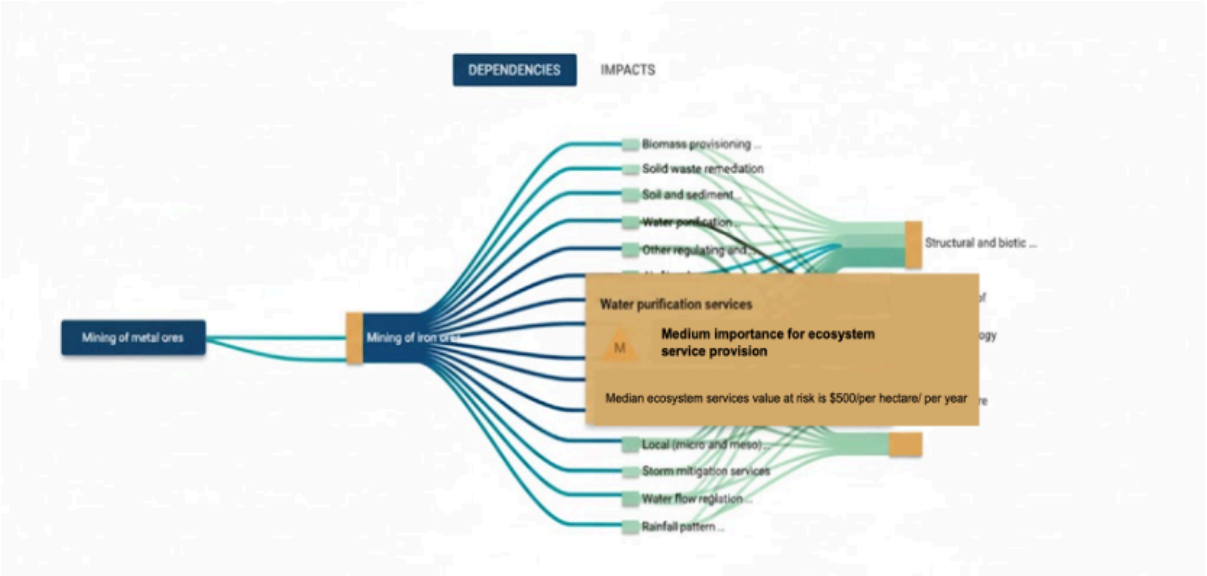

Figure 3. *Potential visualization of the output for ESVaR*

Ecosystem Service	Materiality Rating	Description of Service	Median Value ($/ha/yr)
Global Climate Regulation	🔺 **High**	Contributions to the regulation of atmospheric chemical composition (e.g., carbon sequestration and GHG retention).	**$2,800**
Local (Micro/Meso) Climate Regulation	🔺 **High**	Regulation of ambient atmospheric conditions (e.g., evaporative cooling by urban water bodies and shade provision).	**$950**
Water Purification	🔸 **Medium**	Filtration and decomposition of organic wastes and pollutants in water bodies.	**$350**
Water Flow Regulation	🔸 **Medium**	Natural drainage, buffering, and irrigation provided by water flow patterns.	**$150**
TOTAL			**$4,115**

Figure 4. Potential visualization of the output for ESVaR

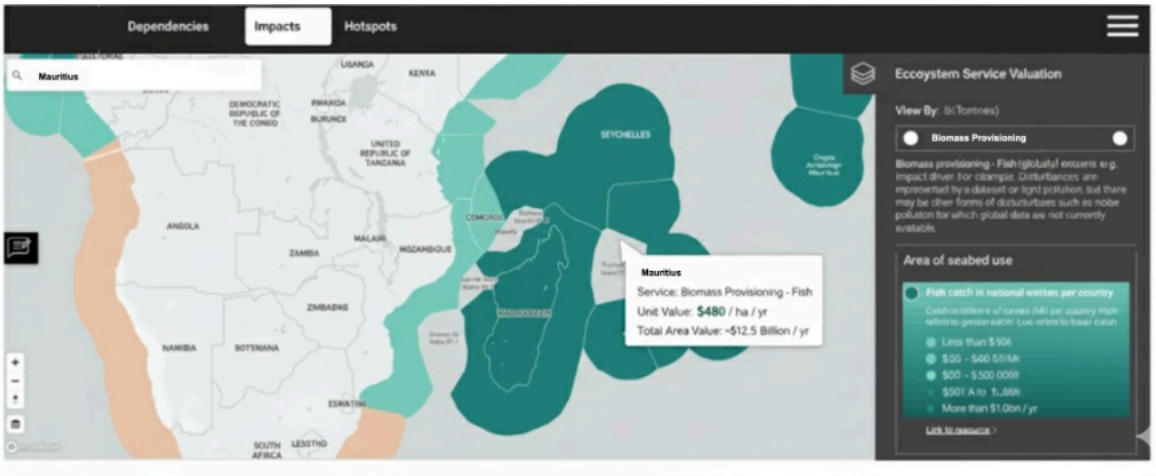

Figure 5. Potential visualization of the output for ESVaR in map format

Nature Risks & Opportunities

- **TNFD Phase: Assess** the risks and opportunities identified to understand their potential financial implications.

- **Output: Community Investment**
  Value of investment in nature-related community development programs
  Sum of Median Ecosystem Services Value x Total Ecosystem Size and/or
  Total value of Ecosystem Services/ Number of Beneficiaries. This output links the estimated economic value of local ecosystem services to potential investment needs or opportunities in community development programs, for example, by comparing the

total ecosystem service value benefiting local populations with the scale of current or planned community investments. This helps identify where nature-based investments could generate the greatest shared value for both businesses and society.

- **Benefit to Business:** Identifies geographies where community dependence on ecosystem services is highest, helping companies prioritize social investment, stakeholder engagement, and benefit-sharing programs to maintain social license to operate. For example, if a mining operation affects ecosystems delivering $10M/year in services to 5,000 local beneficiaries ($2,000 per capita), this frames the scale of community investment or compensation needed to address nature-related impacts and reduce conflict risk.

- **Benefits to Society:** Quantifies the total intended value of ecosystem services and potential number of beneficiaries by stakeholder groups–including Black, Indigenous, and People of Color (BIPOC)--ensuring nature-based investments and compensation programs are scaled appropriately to affected populations and their reliance on local ecosystems.

Figure 6. *Potential visualization of the output for Nature Risks & Opportunities*

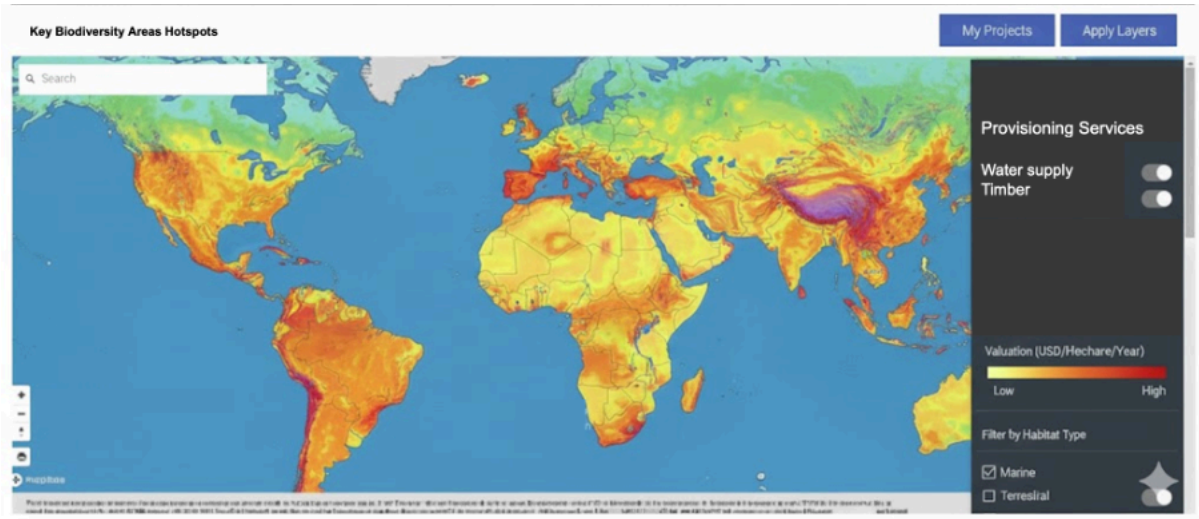

Figure 7. *Potential visualization of the output for Nature Risks & Opportunities*

Use case 2 - Portfolio Screening

Purpose

Risk assessment and portfolio screening were frequently mentioned use cases across interviews. Financial institutions need systematic methods to screen credit and investment portfolios for nature-related risks, quantify monetary exposure using ENCORE dependency materiality ratings and ESVD valuations, and prioritize holdings requiring immediate engagement or divestment considerations.

The purpose of this use case is to enable portfolio managers to transform ENCORE's qualitative sector materiality ratings into actionable financial risk metrics through a two-step process:

(1) **Calculate ESVaR (ecosystem service value at risk):** ENCORE materiality ratings are converted into numeric weights and multiplied by ESVD monetary values to estimate the annual ecosystem service value potentially at risk for each holding. ESVaR represents estimated ecosystem service value potentially affected by company or sector pressures; it is not a probability-weighted or modeled financial loss.

(2) **Generate composite risk scores:** ESVaR is then combined with investment size and location sensitivity data, normalized and weighted to produce a 0-100 composite risk score for each holding, enabling portfolio-level prioritization.

This approach could process portfolios of any size (from 10 holdings to 5,000+ positions) and generate heat maps, risk rankings, and communication materials enabling asset managers to demonstrate risk management to institutional investors.

Clarifying the role and interpretation of ESVaR in portfolio screening

In the portfolio screening use case, Ecosystem Services Value at Risk (ESVaR) is designed as a screening-level exposure proxy, not as a direct measure of ecosystem scarcity, unsustainable use, or expected financial loss. ESVaR combines ENCORE's qualitative sectoral dependency materiality ratings with geographically specific monetary ecosystem service values from the ESVD to express, in monetary terms, the order of magnitude of ecosystem service value potentially affected by portfolio activities.

Importantly, ESVaR reflects societal ecosystem service value, not firm-level dependency value or realised cash flows. High ESVaR does not imply that ecosystem services are scarce or being over-exploited, nor does low ESVaR imply low ecological risk. Rather, ESVaR indicates where portfolio activities intersect with ecosystems that deliver high socio-economic value to people, communities, and sectors, and where disruptions could therefore have wider societal and economic consequences.

As such, ESVaR should be understood as an intermediate analytical step in the evolution of nature-related risk assessment. It supports early-stage portfolio prioritisation by identifying holdings, sectors, or geographies where dependency relevance and socio-economic stakes overlap, signalling where more detailed, context-specific analysis is warranted. Subsequent assessment stages may incorporate additional dimensions such as ecosystem condition, supply–demand balance, local scarcity, mitigation measures, or probability-weighted loss modelling, which are beyond the scope of this scoping study.

By explicitly positioning ESVaR as a dependency-weighted exposure indicator, this use case aligns with current practice in nature-related finance, while acknowledging that fully quantified dependency and risk modelling will require further methodological development and additional data layers in future phases.

Key Features of the use case

- **Ecosystem Service Value at Risk (ESVaR) Metric:** Calculates the annualized value of ecosystem services potentially affected per holding by converting ENCORE materiality ratings to numeric weights and multiplying by ESVD monetary values. This provides a monetary estimate (not a probability-weighted financial loss) for each holding and the total portfolio.

- **Composite Risk Scoring**: Transforms ESVaR and other factors into a standardized 0-100 risk score per holding by combining ESVaR values with investment size and location sensitivity data, applying weights to each factor based on their relative importance and normalizing the combined values to a 0-100 scale for easy comparison.

- **Portfolio Heat Maps**: Visual breakdown by sector, geography, and ecosystem service exposure.
- **"Where to Start" Algorithm**: Auto-prioritizes top holdings requiring immediate action.
- **Red Flag Alerts**: Auto-trigger when holdings exceed pre-defined ecosystem services risk thresholds.
- **One-Click Exports**: Excel reports with company-specific data.

Examples of Outputs

The following are examples of outputs that intend to highlight monetary exposure to nature-related disruption at portfolio and holding level as well as exposure concentration on sector, ecosystem services, and geographic levels. The examples also highlight which holdings to prioritize and act on first, and benchmarking against peers.

As in the previous output, there is an opportunity to include a Value Transfer Function for greater data coverage.

Exposure & Liability Overview

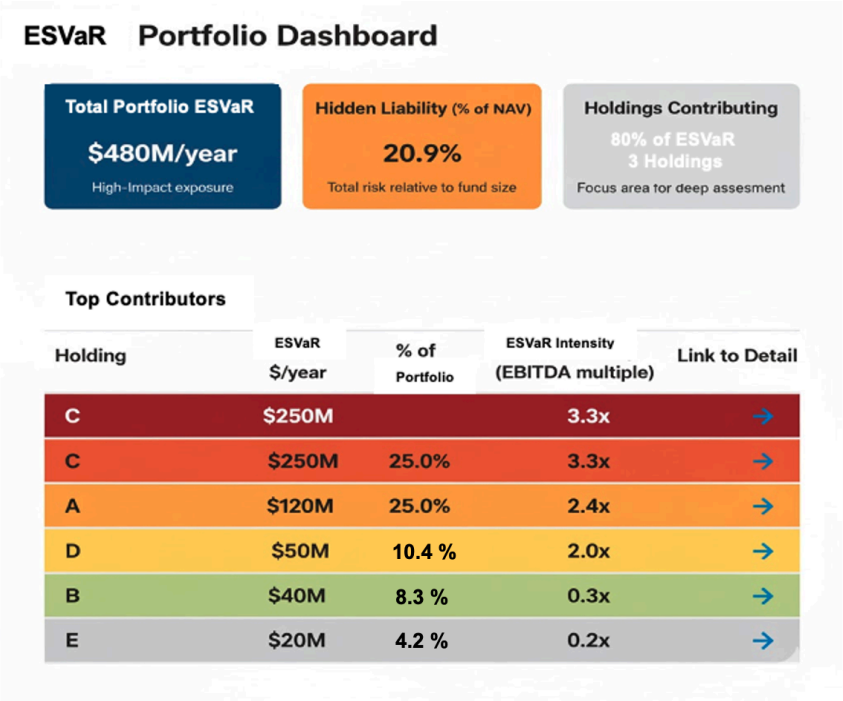

Figure 8. *Potential visualization of the output for Exposure & Liability Overview. Image generated through Google's Gemini 2.5 Flash for illustrative purposes only*

User Inputs: Portfolio Assets Under Management (AUM) breakdown, asset location coordinates, type of asset, asset revenue or EBITDA.

Outputs: A quantified view of monetary exposure in currency terms at both portfolio and holding level, showing:

- Annual ESVaR per holding – Liability estimate per asset.
- Total Portfolio ESVaR – Sum of all holding-level annual ESVaRs.
- Portfolio exposure relative to AUM size (e.g., $487M/year ≈ 21% of Net Asset Value (NAV)) to convey order-of-magnitude financial stakes.
- ESVaR contribution by holding – Each holding's % contribution to Total Portfolio ESVaR (to see the "top contributors").

Investor Benefits:

- Makes portfolio exposure tangible in currency terms to support risk appetite, capital allocation, and engagement resourcing decisions.

- Frames “what’s at stake” for Investment Committees and boards using a monetary estimate derived from ESVD valuations (it is not a probability-weighted VaR or modeled loss forecast).

Concentration & Hotspots

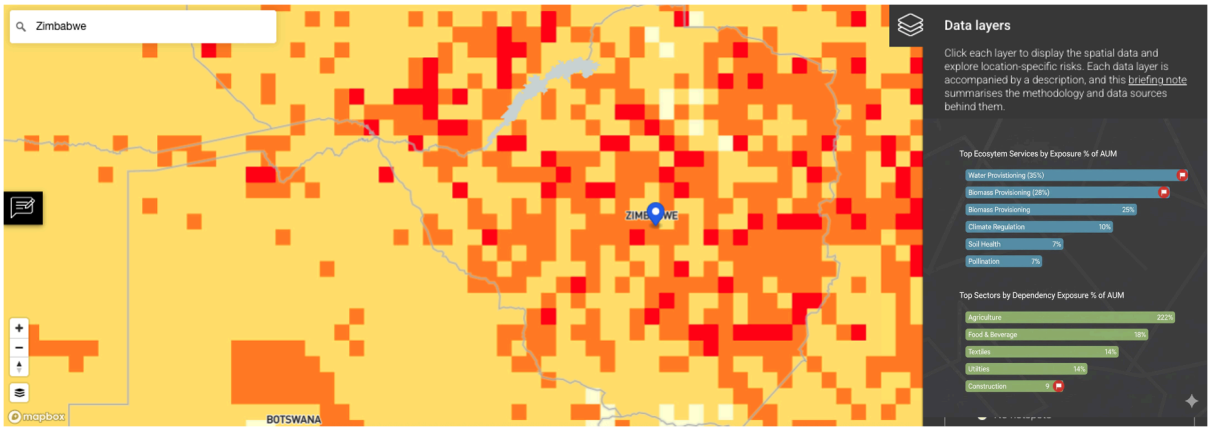

Figure 9. *Potential visualization of ENCORE map with overlay images generated through Google’s Gemini 2.5 Flash for illustrative purposes only*

Inputs: Asset sector and location coordinates.

Outputs: Concentration of exposure by sector, ecosystem service, and place. Possible breakdowns are listed below.

- Ecosystem services dependency concentration – e.g., 47% of AUM depends on Biomass Provisioning.
- ENCORE Pressure concentration – e.g., 62% of AUM exerts ≥5 pressures.
- Geographic ESVaR concentration – e.g., % of total ESVaR by region/country/biome/ecosystem.
- Dominance flags – e.g. a single ecosystem or location share of total ESVaR exceeds threshold >20%.
- Top 3–5 ecosystem services by total AUM exposure.
- Top 3–5 sectors by ecosystem services dependency exposure.
- Spatial hotspots map where ESVaR clusters.
- Median ecosystem service values by location/ecosystem type/asset size to make cross-portfolio comparisons tangible.

Investor Benefits:

- Surfaces sector, ecosystem service, and location concentration to guide diversification, hedging, and targeted due diligence.
- Focuses site-level attention where exposure clusters.

Risk Score & Priority Ranking

Table 2. *Potential visualization of the Risk Score & Priority Ranking*

Rank	Holding	Sector	Country	Composite Risk Score 0-100	Annual ESVaR ($m/yr)	% of Portfolio ESVaR	Confidence	Recommended Action	Primary Driver of risk
1	K	Manufacturing	China	92	85.4	6.80%	High	Immediate engagement	High dependency on water supply; large position in water scarce location
2	B	Agriculture	China	88	63.1	5.00%	Low	Commission assessment	Sparse local valuation evidence; potential hotspot basin
3	C	Mining	Zambia	81	47.6	3.90%	Med	Immediate engagement	Multiple high intensity pressures; mid-large position size
4	L	Textiles	India	77	28.9	2.30%	Med	Quarterly monitoring	Ecosystem service exposure diversified but elevated vs sector peers
5	T	Agriculture	Kenya	71	19.8	1.60%	Low	Commission assessment	Low evidence depth; check local context
6	M	Forestry	Canada	68	17.5	1.40%	Med	Quarterly monitoring	Exposure concentrated in single ecosystem service

Inputs: Asset sector and country/region per holding; position/holding value (absolute or % of portfolio) to size-adjust the score; asset coordinates for location sensitivity; revenue or EBITDA for intensity views.

Outputs: Prioritizes which holdings to act on first and the recommended method of engagement based on a Composite Risk Score (0–100) per holding, combining dependency materiality, monetary exposure (annual ESVaR), size of position, and location sensitivity. The score is designed to be explainable – each component and its weight is shown in the holding's detail.

Institutions could configure custom thresholds aligned with their existing risk frameworks. For illustration, a typical approach might include immediate engagement for high scores (e.g., >80), quarterly monitoring for medium scores (e.g., 60-80), and annual review for lower scores.:

- **Score above 80 with high confidence:** Immediate engagement.
- **Score above 80 with low confidence:** Commission assessment to improve inputs, then decide.
- **Score 60–80:** Quarterly monitoring.
- **Score below 60:** Annual review.
- **Red Flag Alerts**: triggered when predefined thresholds are exceeded (for example, a single ecosystem service or location accounts for more than 20 percent of total portfolio ESVaR, or a holding's ESVaR intensity is in the top decile for its sector).
- **Sector Peer Percentiles:** for each holding (ESVaR, dependency, and pressure intensity versus the sector median or 75th percentile).

Investor Benefits:

- Focuses stewardship and risk resources on the few holdings that matter most now.
- Provides a consistent, auditable rationale for engagement, monitoring, or divestment consideration.
- Adds peer context at the sector and portfolio level so decisions are defensible to investment committees and clients. Also supports reporting alignment with TNFD (2023) and CSRD (2022).
- Reduces bias through a transparent, size-adjusted scoring framework that investment committees and boards can review quickly.

Use case 3 - Project Due Diligence

Purpose

Site-specific investment decision support for development banks, impact investors, and project finance teams to screen and assess whether or not to approve a project. This output identifies borrowers/issuers with credit risk in high-risk geographies, quantifies indicative cost

impacts if ecosystems are impacted (using ESVD-derived monetary values as replacement/alternative sourcing cost proxies), and compares nature-based versus engineered alternatives to inform approve/condition/defer decisions. Frequently cited by interviewees, with strong emphasis from development banks operating in data-poor regions (Africa, Latin America), this tool is designed for pre-investment screening, baseline assessments, and option selection during project design.

It is important to note that ENCORE and ESVD data provide sectoral and ecosystem-level insights that must be complemented with site-specific data and context. In many locations—particularly in data-poor regions—ESVD coverage or study quality may be insufficient for final decision-making without additional primary research. The output flags data gaps and low-confidence areas, prompting users to commission local environmental assessments, stakeholder consultations, or targeted valuation studies before approval. ENCORE and ESVD serve as screening tools to identify where deeper due diligence is warranted, not as substitutes for comprehensive site-level analysis.

Interpretation and Intended Use of ESVaR in Project Due Diligence

In the context of project due diligence, Ecosystem Services Value at Risk (ESVaR) is applied as an indicative impact-oriented screening metric. It represents an estimate of the societal value of ecosystem services currently provided within a defined project area of influence that could potentially be affected by project-related pressures. Unlike portfolio screening applications, where ESVaR reflects dependency-weighted exposure under current conditions, ESVaR in this use case is intended to support early identification of locations where project impacts may have high socio-economic relevance.

ESVaR does not model marginal changes in ecosystem service provision, ecological response functions, or cumulative upstream and downstream impacts. Nor does it represent a probability-weighted financial loss or a regulatory impact assessment. Instead, it provides an upper-bound, order-of-magnitude signal to guide prioritisation, flag locations requiring deeper analysis, and inform decisions on whether more detailed ecological, hydrological, or social assessments are warranted.

In this use case, ENCORE contributes information on sector-specific pressures and ecosystem service dependencies associated with the proposed activity, while ESVD provides location-specific monetary estimates of ecosystem service values benefiting society. Their combined use allows users to identify where potential project impacts could matter most in socio-economic terms, while explicitly recognising that detailed impact prediction and mitigation design remain outside the scope of this screening approach.

Key Features of the use case

- **Site Footprint Assessment:** Activity-to-pressure mapping across the project footprint and area of influence, linked to ecosystem service dependencies.

- **Site ESVaR**: Screening monetary estimate of ecosystem services exposure at site level, in annual currency terms. Site ESVaR is an indicative screening signal reflecting societal ecosystem service value potentially affected within a project's area of influence; it is not a modeled impact forecast or financial loss estimate.
- **Borrower Credit Flags:** Frames ESVaR as indicative replacement/alternative sourcing costs under ecosystem service degradation scenarios (e.g., cost of replacing natural water filtration with engineered treatment).
- **Spatially Explicit Materiality Maps:** Hotspots tied to the project and nearby ecosystems (terrestrial, freshwater, coastal, marine).
- **Alternatives Comparison:** Side-by-side nature-based versus engineered options with exposure reduction and co-benefits.
- **Confidence and Data Gaps:** Evidence depth, geographic match, and recency signals; prompt for technical assistance or local valuation when needed.
- **Decision Memo Pack:** One-click PDF/Excel exports with site summary, metrics, maps, recommended conditions, and citations.

Examples of Outputs

The following are examples of outputs intended to support site-level investment decisions by quantifying monetary exposure, identifying geographic hotspots tied to the project footprint, and comparing design alternatives (nature-based and engineered). All outputs include units, reference years (e.g., USD 2020/ha/yr), and citations to ensure reproducibility and auditability. As in the previous outputs, there is an opportunity to include a Value Transfer Function for greater data coverage.

Site Baseline & Exposure Profile

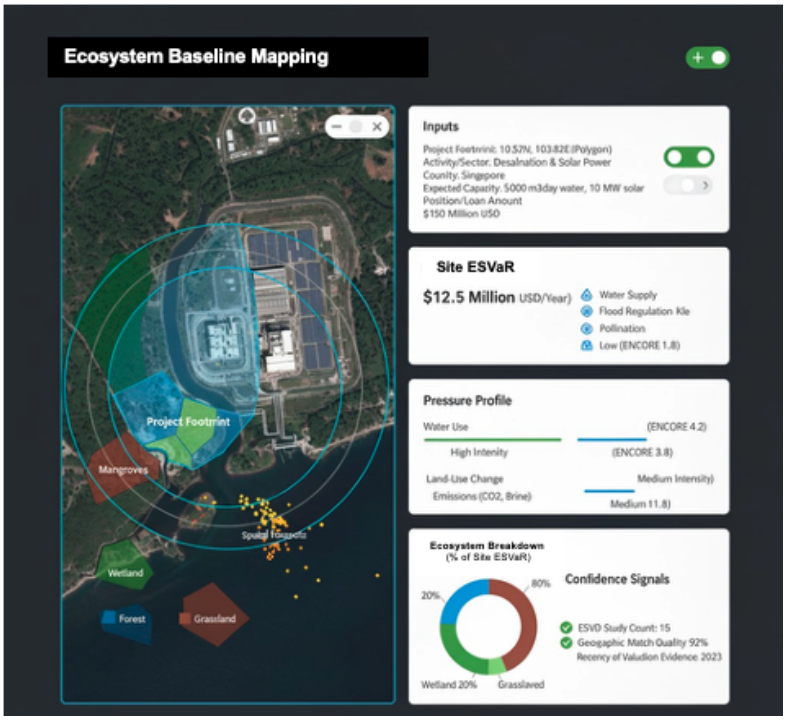

Figure 10. Potential visualization generated through Google's Gemini 2.5 Flash for illustrative purposes only

Inputs: Project footprint (coordinates/polygon), project activity/sector, country, expected capacity/output, position/loan amount for size context.

Outputs: A quantified view of site-level monetary exposure showing:

- Monetary ESVaR estimate (currency/year) for the project footprint and area of influence.
- Key ecosystem services the project relies on (e.g., water supply, flood regulation, pollination) with ENCORE materiality ratings and ESVD values. Grouping results by service category (provisioning, regulation, cultural) for easier interpretation. Providing the option to users to validate the dependency list based on site-specific insights. For precaution, all relevant ecosystem services will be included by default.
- Environmental pressures generated by project activities (e.g., water use, land-use change, emissions) with intensity levels along with the option for users to validate the pressure list based on site-specific insights (e.g., if an Environmental Impact Assessment has already been conducted).
- Hotspots where exposure is concentrated (when coordinates provided).
- Percentage of site ESVaR by ecosystem type (forest, grassland, mangroves, etc.).
- Confidence signals i.e. ESVD study count, geographic match quality, and recency of valuation evidence for the site.

Investor Benefits:

- Establishes a defensible monetary baseline for the investment memo in currency terms decision-makers understand.
- Quickly indicates whether the site warrants deeper due diligence, technical assistance, or local valuation before approval.
- Makes exposure tangible and comparable across projects in the pipeline.

Borrower Credit Risk & Mitigation Conditions

Figure 11. *Potential visualization generated through Google's Gemini 2.5 Flash for*

illustrative purposes only

Inputs: Borrower/issuer profile, site location coordinates, sector/activity type, high-level project economics (capex, revenue projections).

Outputs: Credit risk framing and recommended conditions:

- Elevated credit risk signals for borrowers operating in sensitive geographies (water-scarce basins, biodiversity hotspots, areas with community or resource conflicts).
- Site ESVaR framed as indicative alternative sourcing costs if key ecosystem services degrade (e.g., cost of purchasing water, installing filtration systems, relocating operations).
- Restoration cost estimates (from engineering studies or regulatory requirements) compared against ESVD ecosystem service values to assess whether remediation creates net positive outcomes.
- Flags indicating when to commission targeted local valuation studies (when exposure is high and confidence is low).

Investor Benefits:

- Translates nature-related dependencies into credit language and practical loan covenants that credit committees recognize. This alignment allows integration of nature-related risk indicators directly into credit scoring or Environmental and Social Risk (ESR) frameworks.

- Supports approve/condition/defer decisions with defensible rationale tied to monetary exposure.

Alternatives Comparison: Nature-Based vs. Engineered

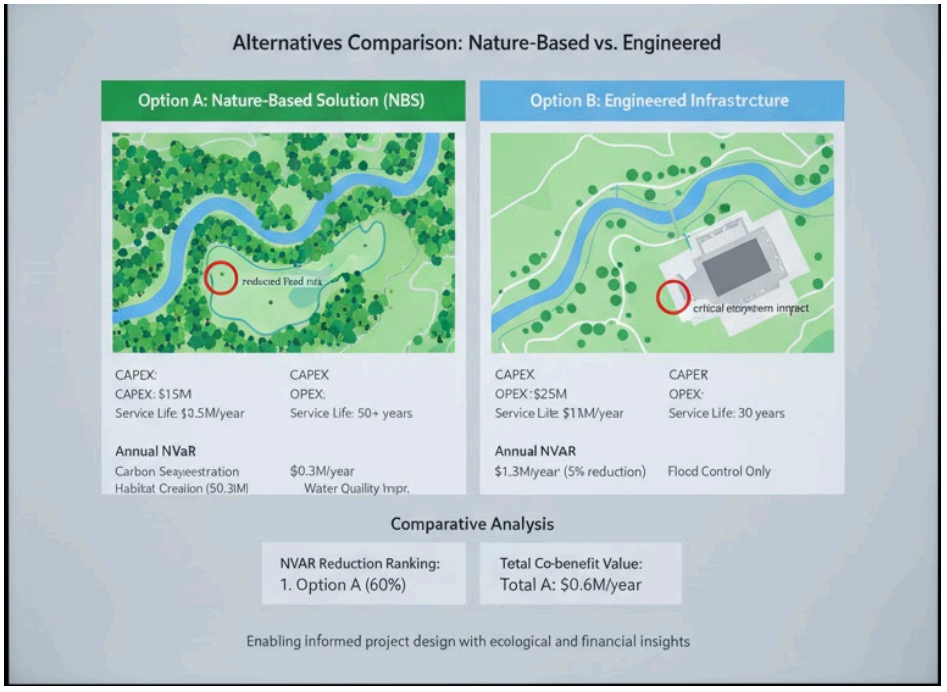

Figure 12. *Potential visualization generated through Google's Gemini 2.5 Flash for illustrative purposes only*

Inputs: Two or more design options for the same project (nature-based solution, engineered infrastructure, hybrid approach), with basic cost and performance parameters (capex, opex, expected service life).

Outputs: Comparative analysis enabling option selection:

- Annual ESVaR exposure (currency/year) per design option and percentage reduction versus baseline or alternative designs.
- Options ranked by magnitude of ESVaR reduction achieved.
- Key nature-based co-benefits and estimated monetary value by option (e.g. carbon sequestration, habitat creation, water quality improvement, recreation, cultural value).
- Spatial overlay mini-maps: How each design option shifts or reduces hotspots in critical ecosystems, showing site-level consequences of design choices.

Investor Benefits:

- Makes design trade-offs explicit in monetary terms alongside technical and environmental considerations.

- Improves project design decisions by revealing options that reduce long-run exposure while meeting performance requirements.
- Creates high-visibility case studies when nature-based solutions achieve comparable performance with lower total cost and exposure.
- Supports climate adaptation and biodiversity finance mandates by quantifying benefits of nature-based infrastructure. Results can also feed into impact reporting frameworks such as CSRD (2022), TNFD (2023), or Green Bond Principles (International Capital Market Association, 2021).