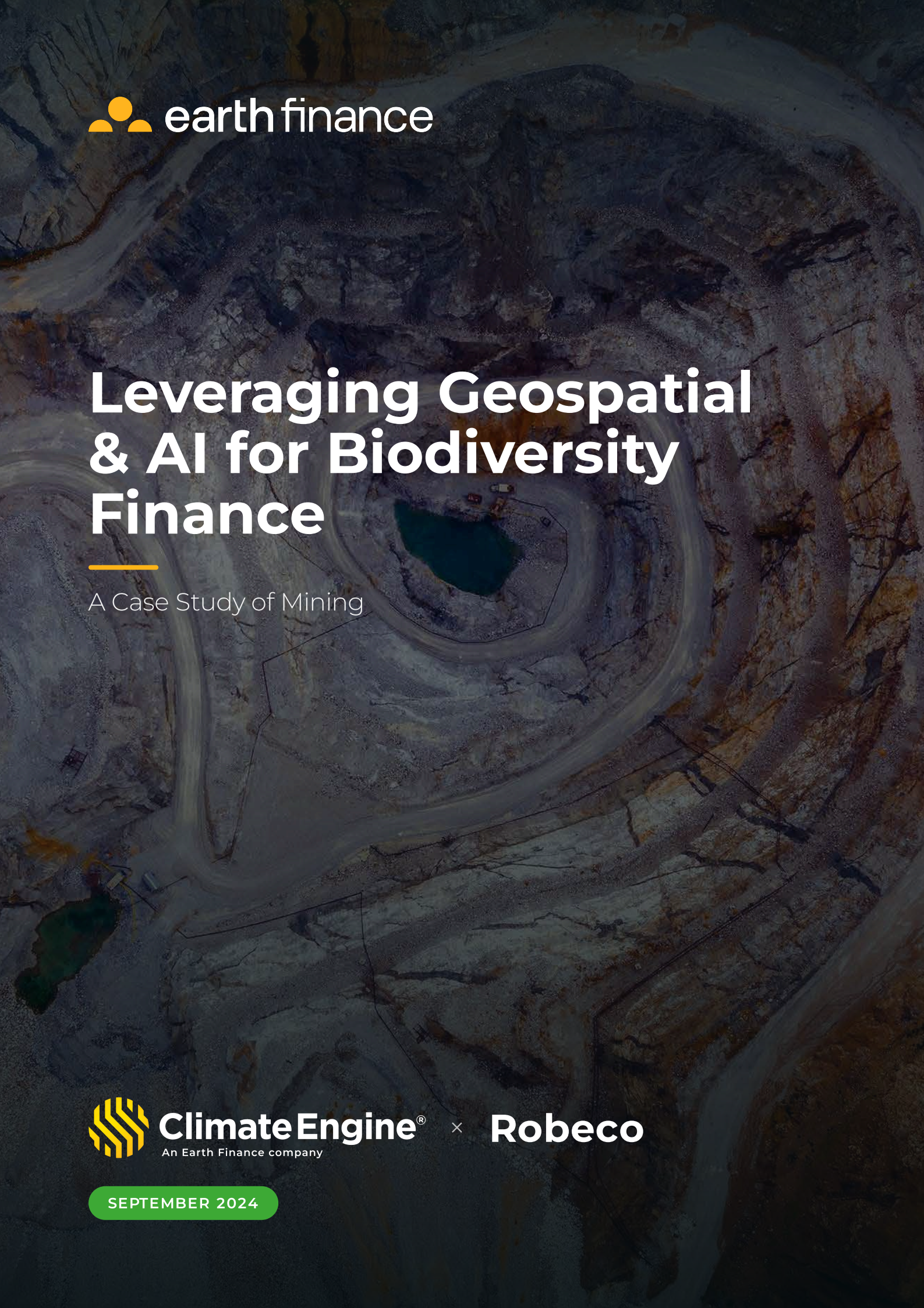


earth finance

Leveraging Geospatial & AI for Biodiversity Finance

A Case Study of Mining

ClimateEngine® An Earth Finance company × Robeco

SEPTEMBER 2024

CONTRIBUTING AUTHORS

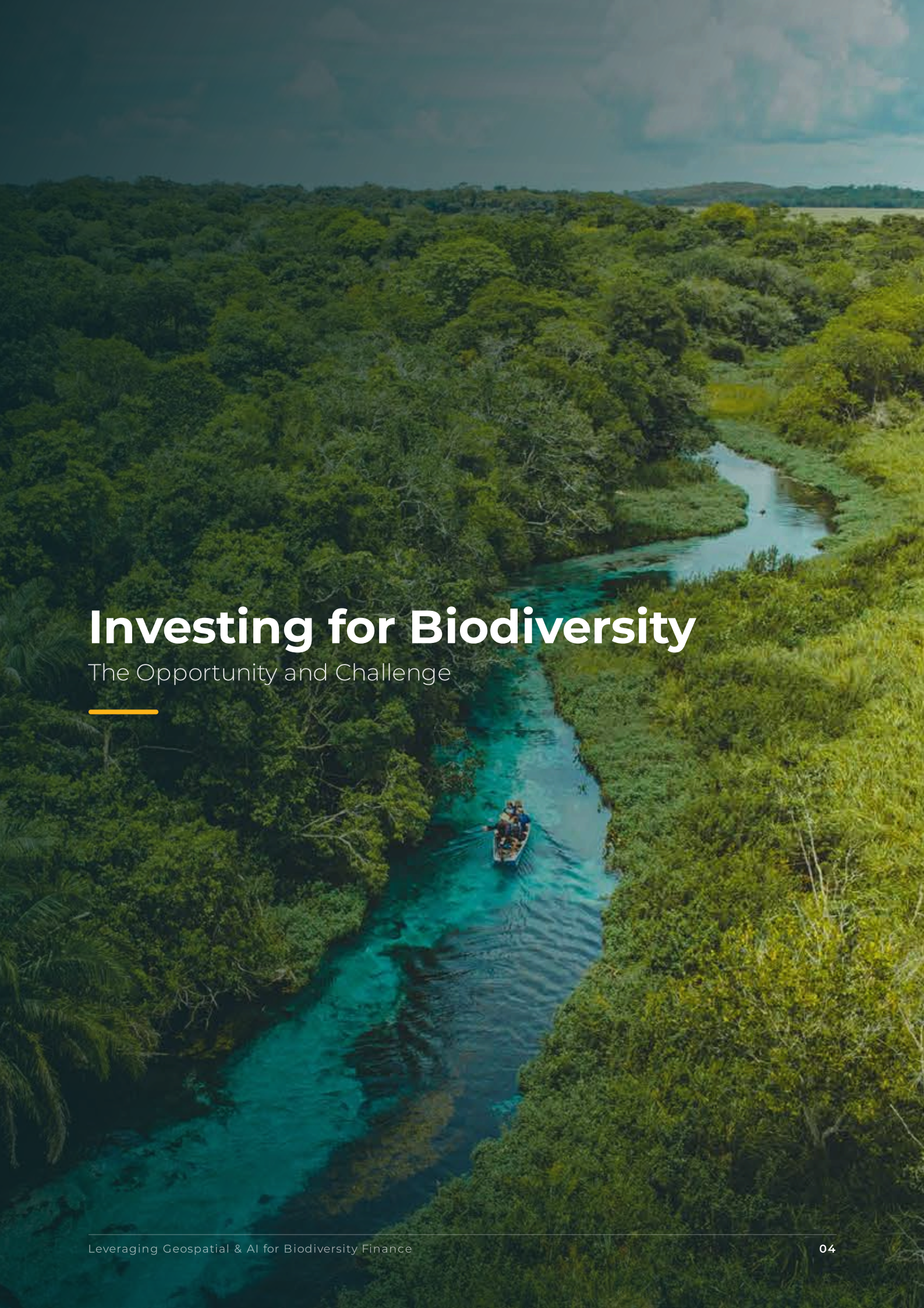
Morgan Williams · Lucian Peppelenbos · Caleb White · Ian Pritchard · Annie Britton · Gabrielle Smith · Jamie Herring

INTRODUCTION

Biodiversity underpins the ecological services that sustain human life on the planet such as pollination, clean water, soil fertility, and carbon sequestration. Biodiversity also underpins the global economy. World Economic Forum research suggests that an estimated US$44 trillion of global value generation — more than half of the world's GDP — comes from industries that are highly (US$13 trillion) or moderately (US$31 trillion) dependent on nature (WEF: 2020). Although biodiversity provides numerous benefits to humans, it is currently facing an unprecedented threat from human activities (WWF: 2024). The root cause of these dramatic losses are human activities that lead to habitat loss, fragmentation, degradation, invasive species, and climate change (IPBES: 2019).

To stem the tide in biodiversity loss, major efforts need to be made to move financial resources to activities that protect precious natural capital. This challenge is at the core of the partnership between Robeco and Climate Engine.

This white paper explores the opportunities and challenges of developing investment strategies for biodiversity and highlights how Robeco and Climate Engine have undertaken a proof-of-concept to research methods for developing a scalable solution for biodiversity finance.



Investing for Biodiversity

The Opportunity and Challenge

INVESTING FOR BIODIVERSITY:

THE OPPORTUNITY AND CHALLENGE

The good news about efforts to protect and restore nature is that there is a growing demand for investments in biodiversity by the global financial community. This interest has translated into at least US$12 billion being raised by funds seeking biodiversity investments in 2022 (Oliver Wyman: 2022), with the number of funds targeting biodiversity increasing by 234%, from 323 funds in 2015 to 1,080 funds in 2024 (Phenix Capital: 2024). However, there are still major financial shortfalls. By 2030, the annual financial requirement for biodiversity is projected to reach US$484 billion, a substantial increase compared to the current funding levels of US$154–166 billion per year. More than 83% of funds currently invested in biodiversity are from public sources (KPMG: 2023) which presents an opportunity for private capital to bridge the gap. Furthermore, the Task Force on Nature-related Financial Disclosures (TNFD) has gained traction globally with over 1,200 companies committing to disclosing under the framework (RBC: 2023). Despite the growing interest in and pressing need for investments in biodiversity, major challenges must be resolved. These include attribution, scalability, and transparency.

Attribution: Human activities that destroy, fragment, degrade, and pollute habitats are key drivers of biodiversity loss. This is well-established science. To build an adequate biodiversity investment strategy, one must understand the specific impacts at specific asset locations with specific ownership attribution. This requires not only understanding where company assets are located but also the biodiversity in those locations and the interplay between these data points. Different assets will affect biodiversity differently. And, conversely, similar assets may also impact biodiversity in diverse ways as impacts can depend on local contexts and management practices. These questions are at the heart of TNFD's LEAP framework. Companies that have committed to disclosing under this framework provide a good starting point for analyzing attribution. However, for companies that don't disclose, the complexities of attributing impacts by third parties is challenging.

Scalability: While it may be possible to assess the impacts of a few assets through desk research, investment funds require global-scale insights across thousands of companies and potentially millions of assets. Achieving this scale demands automated systems capable of attributing biodiversity impacts to company assets and monitoring the dynamic nature of biodiversity loss and potential regeneration.

Transparency: While sustainability reports can provide valuable information, claims must be verified to ensure investor confidence and allow for comparisons across different assets and companies when building investment portfolios. This level of trust and transparency is critical to avoid greenwashing and ensure that investment funds are built effectively.

INVESTING FOR BIODIVERSITY:

THE OPPORTUNITY AND CHALLENGE (CONTINUED)

The challenge is thus both methodological and technological. A scientific methodology is needed to identify company assets and their locations, rank the biodiversity health and importance of asset locations, and determine the assets' risk exposure to biodiversity impacts. At the same time, a technological solution is required to both enable the global scale that is vital to the investment community and to provide mechanisms for transparent result inspection, thereby maintaining investor confidence.

> **By 2030, the annual financial requirement for biodiversity is projected to reach $484 billion which presents an opportunity for private capital to bridge the gap.**
>
> KPMG, 2023

Engineering Investments for Biodiversity

A Spatial Finance Methodology

ENGINEERING INVESTMENTS FOR BIODIVERSITY:

A SPATIAL FINANCE METHODOLOGY

Robeco and Climate Engine have partnered to meet these biodiversity investment challenges through the application of a spatial finance approach. Spatial finance is the integration of geospatial data and analysis into financial decision-making. The spatial element is key for investment strategies built around environmental factors such as climate, biodiversity and water as oftentimes the impacts companies make are locally specific. Thus, a combination of asset location data and environmental data relevant to these locations is required. For financial market participants to take advantage of the resulting insights, there needs to be products available to them. This is where investment managers can make their contribution, by offering strategies built using this localized data.

Through this partnership, Robeco and Climate Engine are leveraging AI, geospatial technologies, scientific expertise, and extensive investment knowledge to explore how to leverage new technologies for fund management around issues of biodiversity. This system is being designed to automate the identification of company asset locations, assess how the activities at these assets impact local biodiversity, and ultimately provide data that can be used directly in investment strategies. The objective is to deliver insights into how publicly traded companies are interacting with biodiversity through the attribution of risks and impacts to provide transparency at the level of individual assets while also enabling global scalability.

> **Investment managers can make their contribution to biodiversity protection by offering strategies built using localized data.**

ENGINEERING INVESTMENTS FOR BIODIVERSITY:

A SPATIAL FINANCE METHODOLOGY (CONTINUED)

Attribution: To adequately attribute impacts to companies, we must know three main components: (1) where company assets are; (2) what the conditions of biodiversity are at asset locations; and (3) how the assets impact biodiversity. Combining these three elements help produce an exposure risk that can be calculated and laddered up to the company level. These include:

Company Assets: To identify the assets that a company owns or relies upon, a methodology that leverages GenAI and web scraping tools was developed to pull year end reports from relevant publicly traded companies, extract the location of key assets, and store this data in a format friendly for spatial analysis.

Biodiversity: Knowing the status of biodiversity at the location of an asset is a critical step. This step was produced using a method that combines open and scientifically validated data from the world's top science organizations to produce a global dataset that can be used to understand both the general biodiversity health of an area as well as its importance in terms of conserving key ecological functions and diversity.

Asset Impacts: Finally, we require a step to understand the interplay between an asset and biodiversity. Using a similar process as described above, we developed and tested Gen AI prompts to extract key asset information including what functions the assets have. This is key as the operational impact of assets such as office buildings will have very different impacts as those of extractive industries. This step allows us to identify what activities are occurring at an asset and to grade what the likely biodiversity impacts of those activities are.

Scalability: To run the attribution methodology at scale, a cloud-based pipeline was produced that can automate this process. This level of scale and automation is key for building investment guidance as it can provide the breadth of insights needed to assess multiple companies across a multitude of varying assets. To enable this scale, this process relies heavily on Google Cloud based geospatial and AI tools including Gemini, BigQuery, Earth Engine and Vertex AI.

Transparency: The process laid out above helps solve the issue of transparency as it provides the ability to drill down to specific assets to truly understand how company level statistics are derived. To ensure that this can be done, all outputs are mapped in geospatial formats that can be explored through a mapping user interface (UI).

As part of the collaboration between Robeco and Climate Engine, the methodology and technology system were designed to be globally scalable while recognizing that different industries impact biodiversity in unique ways. Due to these complexities, not all assets can be treated equally. Therefore, the methodology includes applying weightings to different asset types, ensuring that the results more accurately reflect the diverse ways in which business activities can impact biodiversity.

Assessing Mining Risk Exposure

A Case Study

CASE STUDY:

ASSESSING MINING RISK EXPOSURE

To validate the methodology and technology, the system was applied to the mining industry to develop metrics for assessing the relative biodiversity impacts of publicly traded mining companies. Mining was selected as it significantly impacts biodiversity, occurs across diverse global landscapes, and involves varying levels of destruction depending on the mining method (e.g., mountaintop removal vs. placer mining) and the type of commodity extracted, which can vary in pollution levels. This makes mining an ideal testing ground for the system. For this case study, a list of 109 publicly traded mining companies was compiled, representing a range of commodity types and locations around the world.

TABLE 1 — MINING COMPANIES INCLUDED IN THE CASE STUDY

Agnico Eagle Mines	Freeport-McMoRan Inc	Lundin Mining Corp	Sinomine Resource Group Co Ltd
Aluminum Corp of China	GEM Co Ltd	MMG Ltd	South32 Ltd
Amman Mineral Internasional	Gerdau SA	Merdeka Copper Gold Tbk PT	Southern Copper Corp
Aneka Tambang	Glencore PLC	Mineral Resources Ltd	Steel Dynamics Inc
Anglo American	Gold Fields Ltd	NMDC Ltd	Sumitomo Metal Mining Co Ltd
Anglo American Platinum	Grupo Mexico SAB de CV	Nanjing Iron & Steel Co Ltd	Tata Steel Ltd
Anglogold Ashanti	Guangdong HEC Technology	Newmont Corp	Teck Resources Ltd
Antofagasta	Harmony Gold Mining	Nippon Steel Corp	Tianshan Aluminum Group Co Ltd
ArcelorMittal SA	Henan Shenhuo Coal & Electricity	Norsk Hydro ASA	Tongling Nonferrous Metals Group
BHP Group	Hesteel Co	Northam Platinum Holdings Ltd	Vale SA
Baoshan Iron & Steel Co	Hindalco Industries	Northern Star Resources Ltd	Vedanta Ltd
Barrick Gold Corp	Huaibei Mining Holdings Co	Nucor Corp	voestalpine AG
BlueScope Steel	Hunan Valin Steel Co	POSCO Holdings Inc	Western Mining Co Ltd
Boliden AB	Hyundai Steel Co	Pan American Silver Corp	Western Superconducting Tech
CMOC Group	Impala Platinum Holdings	Pangang Group Vanadium Titanium	Wheaton Precious Metals Corp
Chifeng Jilong Gold Mining	Industrias Penoles SAB de CV	Pilbara Minerals Ltd	Xiamen Tungsten Co Ltd
China Hongqiao Group	Inner Mongolia BaoTou Steel Union	Press Metal Aluminium Holdings	Yintai Gold Co Ltd
China Northern Rare Earth Group	Ivanhoe Mines	Reliance Inc	YongXing Special Materials Tech
China Rare Earth Resources & Tech	JCHX Mining Management Co	Rio Tinto Ltd	Yunnan Aluminium Co Ltd
China Steel Corp	JFE Holdings Inc	Rio Tinto PLC	Yunnan Chihong Zinc & Germanium
Cia Siderurgica Nacional SA	JSW Steel	Saudi Arabian Mining Co (Ma'aden)	Yunnan Tin Co Ltd
Cia de Minas Buenaventura SAA	Jiangxi Copper Co	Shandong Gold Mining Co Ltd	Zhaojin Mining Industry Co Ltd
Citic Pacific Special Steel	Jindal Stainless	Shandong Nanshan Aluminum Co	Zhejiang Huayou Cobalt Co Ltd
Cleveland-Cliffs Inc	Jindal Steel & Power	Shanxi Meijin Energy Co Ltd	Zhongjin Gold Corp Ltd
Endeavour Mining PLC	Jinduicheng Molybdenum Co	Shanxi Taigang Stainless Steel	Zijin Mining Group Co Ltd
Eregli Demir ve Celik (Erdemir)	KGHM Polska Miedz SA	Sibanye Stillwater Ltd	
First Quantum Minerals	Kinross Gold Corp		
Fortescue	Korea Zinc Co Ltd		
Franco-Nevada Corp	Kumba Iron Ore Ltd		

CASE STUDY:

ASSESSING MINING RISK EXPOSURE (CONTINUED)

To gather location-specific asset data, the first step involved automating the collection of company annual reports. From the original list, we collected 105 annual reports. We then processed these reports using an AI model built on top of Google Gemini to extract mine ownership information and relevant details such as commodity type, operational status, and mine type. This resulted in 1,661 identified mines. To determine the physical locations of these mines, each was geolocated using a combination of information from the annual reports, open data, and the Google Maps API. The resulting data were stored in Google BigQuery to leverage its geospatial capabilities. The mines and their associated weightings were then mapped to biodiversity and risk exposure data to produce the final data at the asset level.

Initial findings include:

- **81%** of mining companies sampled have at least one asset sharing a watershed with a Key Biodiversity Area or a Protected Area.
- **43%** of all mines sampled share watersheds with a Key Biodiversity Area or a Protected Area.
- **54%** of copper mines and **43%** of gold mines sampled are located in watersheds containing Key Biodiversity Areas or Protected Areas.
- **39%** of mines sampled using high-risk methods like open-pit mining are within regions of high biodiversity importance.
- **34%** of surface mines sampled are within 1 kilometer of a river or waterway, increasing the risk of water contamination and ecosystem disruption in these areas.

Future Directions

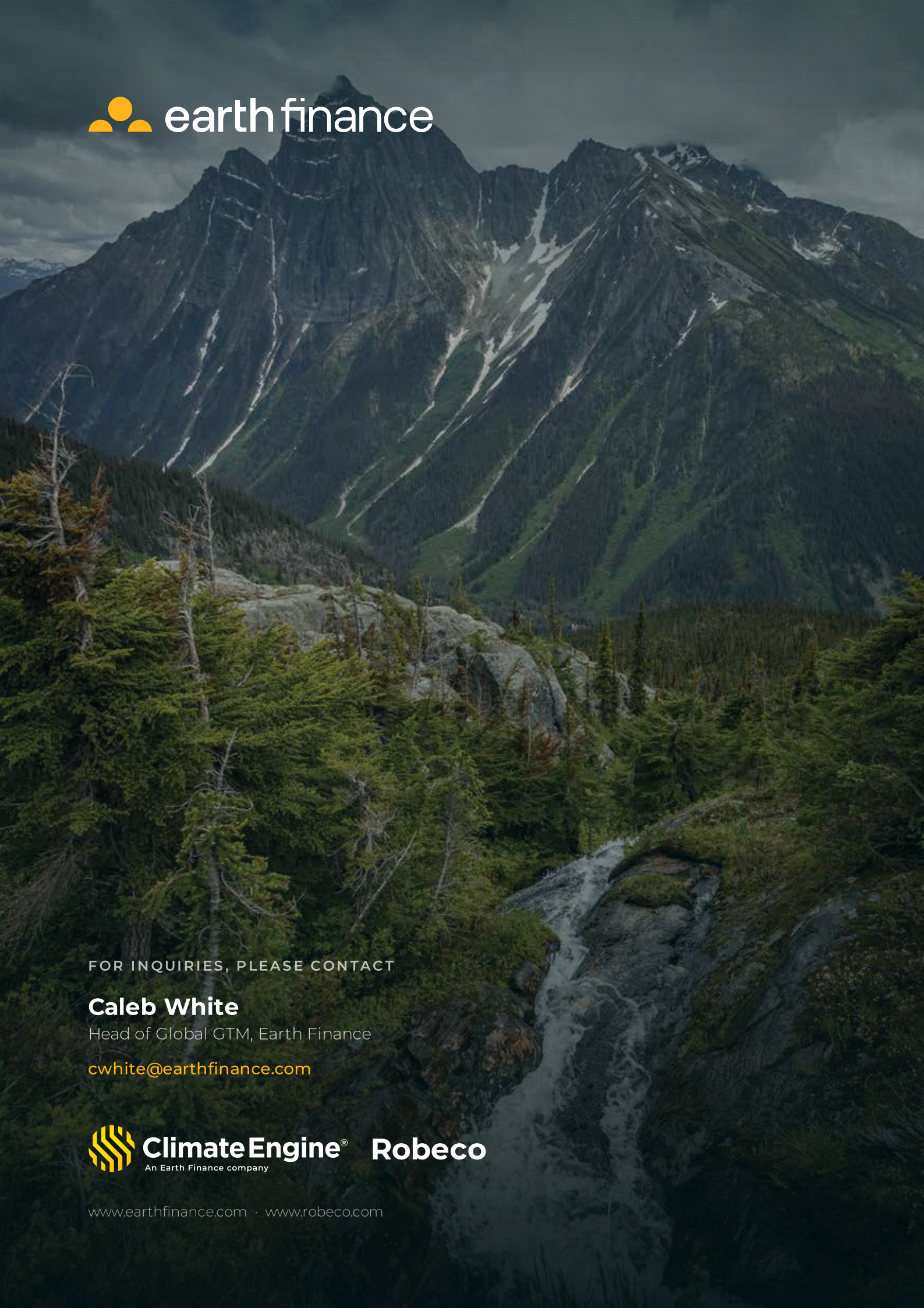
FUTURE DIRECTIONS

This collaboration between Robeco and Climate Engine has only begun to uncover the unparalleled transparency possible through combining geospatial data, AI, and deep investment knowledge to understand the connections between the environment and the economy. Future work will include assessing how we can use this approach throughout the investment value chain. We see particular value in applications such as investment research and stewardship. It will also include applying the same methodology and technology system to other industries that are known to have out-sized impacts on biodiversity. Additionally, there will be a focus on introducing satellite data to track and analyze corporate claims regarding biodiversity plans and policies.

ABOUT ROBECO AND CLIMATE ENGINE

Robeco is a pure-play international asset manager founded in 1929 with headquarters in Rotterdam, the Netherlands, and 16 offices worldwide. A global leader in sustainable investing since 1995, its integration of sustainable as well as fundamental and quantitative research enables the company to offer institutional and private investors an extensive selection of active investment strategies, for a broad range of asset classes. On 31 March 2024, Robeco had EUR 194 billion in assets under management, of which EUR 190 billion was committed to ESG integration. Robeco is a subsidiary of ORIX Corporation Europe N.V. More information is available at www.robeco.com.

Climate Engine, an Earth Finance company, helps organizations deliver on their climate and biodiversity goals through the application of geospatial technology, Earth science, and AI. To do this, Climate Engine has brought together experts in Earth sciences, finance, and computing to help bring Earth data into decision making. Our clients include some of the largest and most forward thinking financial institutions and corporations. Our mission is to connect the worlds of economic and environmental data to help support mission driven leaders to realize their ambitions to build a better, more sustainable future.


earth finance
FOR INQUIRIES, PLEASE CONTACT
Caleb White
Head of Global GTM, Earth Finance
cwhite@earthfinance.com
ClimateEngine®
An Earth Finance company
Robeco
www.earthfinance.com · www.robeco.com