WESTPHALEN FOREST CARBON PROJECT

Document Prepared by Zimmfor Management Services Ltd.

Project Title	Westphalen Forest Carbon Project
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Prepared By	Zimmfor Management Services Ltd.
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Matthias Graf von Westphalen (Westphalen) is developing a forest, carbon offset project to achieve greenhouse gas (GHG) emission reductions and removals through the conservation of privately owned logged to protected (LtPF) forests. The project will be implemented following the Verified Carbon Standard (VCS) VM0012 – Improved Forest Management in Temperate and Boreal Forests (LtPF), v1.2 methodology. The project area encompasses properties owned by Westphalen, and Westphalen has the authority to implement project activities on the properties, such as a carbon crediting project by directing forest planning within the current (single) project activity instance (PAI).

The geographic area of the project is composed of nine regions located in Germany and occupies approximately 772 hectares (ha). These areas are non-contiguous and are comprised of a mosaic of freehold properties owned and operated by Westphalen in the states of Schleswig-Holstein, Thuringia, North Rhine-Westphalia, and Lower Saxony. Properties were managed for timber harvest prior to the implementation of the carbon crediting project and managed under a forest management plan created in 2015.

Carbon emission offsets were calculated by comparing the project scenario which ceases all timber harvesting, to a baseline scenario which represents regular forest harvesting operations. Carbon pools were estimated with the Operational-Scale Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) – Version 1.2, allowing for the calculation of carbon emission offsets. The baseline scenario for the project will be the continuation of legally permitted commercial harvesting for the next 30 years. The harvest schedule is implemented under the baseline scenario using selective thinning and final felling, which are regionally appropriate forest management practices.

The project scenario is designed to conserve current forest conditions where the carbon crediting project has been implemented by Westphalen. The project will involve low levels of harvest activities to maintain forest health, enhance ecological conditions, and/or mitigate risks. It is estimated that the project will sequester ~211,000 tonnes of carbon dioxide equivalent (tCO_2e) from the atmosphere over the 30-year project period, averaging approximately 7,000 tCO_2e per year.

No historic crediting period data is applicable at this time as the project is currently seeking initial validation and verification.

It is the intention of the project proponent to maintain the project activities for 100 years.

Table 1. Audit History

Audit Type	Period	Program	VVB Name	Number of years
Validation	28-April-2023	VCS Program	RINA Services S.p.A (RINA)	n/a
Verification	01-January-2018 – 31-December-2021	VCS Program	RINA Services S.p.A (RINA)	4 years
Total	-	-	-	4 years

1.2 Sectoral Scope and Project Type

Sectoral Scope 14

Improved Forest Management (IFM)

Logged to Protected Forest (LtPF)

The Westphalen Forest Carbon Project is a grouped project, allowing for the addition of PAIs following project validation.

1.3 Project Eligibility

The Westphalen Forest Carbon Project (and specifically the current PAI) will reduce net GHG emissions through the elimination of harvesting in the project area, thereby converting logged forests to protected forests. This satisfies the criteria for VCS Improved Forest Management – Logged to Protected Forests (IFM-LtPF) projects as defined in the VCS Standard v4.4 and the applicability condition as described within the VCS-VM0012 methodology:

1. The project (and specifically the current PAI) meets the most recently approved criteria for VCS IMF eligible projects.
    - Will increase sequestration and reduce emissions of forest l and managed for wood products (sawtimber), by increasing biomass carbon stock through improving forest management practices.
    - The baseline and project scenarios for the project area are forests remaining forests.
    - The project area is designated for wood product management by a national regulatory body (refer to Section 1.7 Ownership).
2. The project (and specifically the current PAI) meets the most recently approved criteria for VCS Logged to Protected Forests (LtPF) eligible projects.
    - The project includes the practice of converting logged forests to protected forests.

- By eliminating harvesting for timber, biomass carbon stocks are protected and ca increase as the forest re-grows and continues to grow.
- Small amounts of harvesting to maintain stand health (removal of dead trees) will continue in the project scenario.

3. The project (and specifically the current PAI) is within the Temperate Global Ecological Zone (as defined by Food and Agriculture Organization of the United Nations (FAO) (FAO, 2001) (see Appendix 10), are forest lands remaining forest lands (as defined by IPCC (IPCC, 2003)), and which meet IPCC GPG LULUCF Tier III inventory and data requirements (IPCC, 2003).
4. The project (and specifically the current PAI) meets the most current approved VCS Standard requirements for ownership, by being able to demonstrate Proof of Right and Right of Use ownership of carbon rights in accordance with VCS requirements:
    - Westphalen – fee simple ownership of the land, title rights and carbon rights (for further information refer to Section 1.7 Ownership).
5. There are de minims (less than 5%) amounts of illegal, unplanned or fuelwood removals from the PAI in the baseline scenario.
6. The project (and specifically the current PAI) area does not encompass peatland forests as defined by IPCC GPG LULUCF (see Appendix 9).
7. The project (and specifically the current single PAI) area does not include wetlands.
8. There is no planned compensatory harvesting on other lands held by owners of the PAI. Activity shifting leakage will be monitored and reported annually as required by VCS standards.
9. Westphalen forest management will not apply organic or inorganic fertilizer in the project scenario.

Future (new) PAI(s) will only be included in the project when the above (and those noted in section 1.4.1) eligibility criteria are met.

1.4 Project Design

The Westphalen Forest Carbon Project is a grouped project to allow multiple project instances to be established within the project area (See Section 1.12). Conditions within the project area at the time of validation have been used to create the baseline scenario and determine project additionality. The baseline scenario and additionality assessments have been completed within one clearly defined geographic area for the Westphalen Forest Carbon Project (Figure 1). One project activity instance has been implemented under the VM0012 methodology. Additional project instances may be implemented following initial project validation.

1.4.2 Eligibility Criteria

Inclusion of additional PAIs in the Westphalen Forest Carbon Project must adhere to the following eligibility criteria:

1. The PAI must meet the applicability conditions defined in the most recent version of the VCS methodology VM0012 – Improved Forest Management in Temperate and Boreal Forests (LtPF), or conditions specified in the applicable methodology selected.
2. The new PAI must utilize all technologies or measures used in this document and must satisfy the conditions of the selected methodology. Any novel technologies utilized shall be clearly identified and defined.
3. Technologies or measures shall be applied in a similar fashion as outlined in this project description document.
4. The PAI will utilize the same baseline scenario as described in Section 3.4 or a baseline scenario appropriate to the specified methodology for the geographic area defined in Section 1.12.
5. The PAIs will have characteristics with respect to additionality that are consistent with the initial instance of the project and geographic area. Such characteristics include financial and technical parameters or barriers.
6. Additional activity instances must also satisfy inclusion requirements for Grouped Projects as outlined in the VCS Standard v4.4, Section 3.6 (Project Design).
7. The PAI must use the GHG information systems and controls (or equivalent) in use by the Project Proponent, Project Developer and/or the Implementation Partner.
8. No new instances may be added which overlap with any of the components of another AFOLU project's zone (as defined by the VCS Standard v4.4, Section 3.6.12).

For clarity, the current PAI meets the eligibility criteria noted above.

1.4.3 GHG Information Systems and Controls

GHG Information systems include but may not be limited to the following:

1. Carbon Budget Model of the Canadian Forest Service (CBM-CFS3)
2. Harvested Wood Products model from Zimmfor Management Services Ltd.
3. Emission model from Zimmfor Management Services Ltd.
4. MARketz Tool from Zimmfor Management Services Ltd.
5. Uncertainty model from Zimmfor Management Services Ltd.

GHG controls include but may not be limited to the following:

1. Standard Operating Procedure – Monitoring; from Zimmfor Management Services Ltd.
2. Standard Operating Procedure – Stakeholder Consultation + Engagement; from Zimmfor Management Services Ltd.

1.5 Project Proponent

Table 2. Project Proponent Information

Organization name	Matthias Graf von Westphalen
Contact person	Dr. Johannes Gerst
Title	Forest Manager
Address	CENTRALVERWALTUNG, LAER 3, MESCHEDE, GERMANY, 59872
Telephone	+49 2953 8007
Email	j.gerst@graf-von-westphalen.de

1.6 Other Entities Involved in the Project

Table 3. Information of Other Involved Entities

Organization name	Zimmfor Management Services Ltd.
Role in the project	Listing Representative, Authorized Representative, Implementation Partner, Project Developer
Contact person	Jason Zimmermann, RPF
Title	President
Address	2218-D Airport Drive, Campbell River, BC, V9H E2, Canada
Telephone	+1 604 619 1585
Email	jason@zimmfor.com

1.6.1 Roles and Responsibilities

Authorized Representative (Zimmfor Management Services Ltd.)

- Communicate with and provide instructions to the Verra Registry on behalf of the Project Proponent(s).
- Designate the account into which VCU's may be deposited.

Implementation Partner (Zimmfor Management Services Ltd.)

- Work in partnership with the Project Proponent(s) to obtain project validation.
- Assist with obtaining verified carbon units through verification audits.
- Perform project monitoring requirements (including field work and follow-up required reporting).

Project Developer (Zimmfor Management Services Ltd.)

- Develop and provide all required deliverables for project validation/verification including but not limited to:
  - Project Description Document
  - Project Monitoring Report
  - AFOLU Non-permanence Risk Assessment
  - Completed VCS Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities
  - Baseline and project carbon modelling
  - Stakeholder and Community Engagement reference materials
  - Standard Operating Procedures for project implementation and validation

1.7 Ownership

Forest Lands within the Westphalen Forest Carbon Project are legally owned by Matthias and August Graf von Westphalen. Management of forest resources and implementation of forest operations and plans fall under the directives of Westphalen management representatives in accordance with the federal forest policy framework. Westphalen consents to the implementation of the carbon crediting project on their privately owned estate lands. Westphalen has the rights to the carbon credits generated from this project.

Forestland ownership rights in Germany are determined via the German Constitution[1] and the Bürgerliches Gesetzbuch[2] (Civil Code). Estate ownership documents are verified within the Land Charge Register Grundbucheintrag (entry in the Land Book) which are held at local courts. The legal owner of the estate also owns the management rights to the lands. Each land parcel is identified by a District Name, and a Hall and Parcel numeric value.

The Westphalen Forest Carbon Project area is part of a much larger privately owned land base. Land registry documents verifying ownership of the Westphalen properties included in the project area were provided by law firms Peus Bethke and Raudszus & Partner. Samples of specific properties included in the project are provided below. The notarized Land Charge Registry will be provided to the validation body for each land district parcel upon request.

Table 4: Supporting Property Ownership Information [sample]

District	Hall.	Parcel	Cadastral Zone	Department	District Identifier GIS Key
Glashütte	31	40	05_2926	111C	00940101-0111-C-H010
Körbecke	10	87	05_2371	633A	00940606-0633-A-H010

[1] Grundgesetz für die Bundesrepublik Deutschland vom 23. Mai 1949 (BGBl. I S. 2438) “German Constitution” - Article 14 In Germany, ownership of land is protected under the constitution by Article 14 Subsection 1 Sentence 1 Basic Law which guarantees private ownership as a legal institution.
[2] Bürgerliches Gesetzbuch (BGB) in der Fassung der Bekanntmachung vom 2. January 2002 (BGBl. I S. 42, 2909; 2003 I S. 738) "German Civil Code “- § 873 (1): Acquisition by agreement and registration

1.8 Project Start Date

The Westphalen Forest Carbon Project start date is January 1, 2018. As defined in the approved Forest Management Plan (effective July 2015), the Project Proponent has been legally entitled to harvest timber; effective January 1, 2018, all harvesting activities within the project areas have been curtailed in relation to the volumes authorized in the 10-year Forest Management Plans (FMP).

1.9 Project Crediting Period

Project activities were initiated on 01 of January of 2018 and will be completed on the 31st of December of 2047. The project period will be 30 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The Westphalen Forest Carbon Project estimates generating approximately 220,000 tonnes of CO2e over the project's lifetime.

Table 5: Project Scale

Project Scale	
Project	X
Large project	

The estimated annual GHG emission reduction/removals of the project are:

Table 6: Estimated GHG Emission Reductions and Removals

Year	Estimated GHG emission reductions or removals (tCO2e)
01-January-2018 - 31-December-2018	3,080
01-January-2019 - 31-December-2019	255
01-January-2020 - 31-December-2020	2,646
01-January-2021 - 31-December-2021	10,133
01-January-2022 - 31-December-2022	-7,294
01-January-2023 - 31-December-2023	8,154
01-January-2024 - 31-December-2024	9,039
01-January-2025 - 31-December-2025	9,397
01-January-2026 - 31-December-2026	13,471
01-January-2027 - 31-December-2027	8,122
01-January-2028 - 31-December-2028	8,318
01-January-2029 - 31-December-2029	8,225
01-January-2030 - 31-December-2030	8,108
01-January-2031 - 31-December-2031	8,122

01-January-2032 - 31-December-2032	7,611
01-January-2033 - 31-December-2033	8,312
01-January-2034 - 31-December-2034	8,174
01-January-2035 - 31-December-2035	8,192
01-January-2036 - 31-December-2036	8,488
01-January-2037 - 31-December-2037	6,666
01-January-2038 - 31-December-2038	8,209
01-January-2039 - 31-December-2039	7,790
01-January-2040 - 31-December-2040	7,296
01-January-2041 - 31-December-2041	7,474
01-January-2042 - 31-December-2042	6,150
01-January-2043 - 31-December-2043	7,594
01-January-2044 - 31-December-2044	5,021
01-January-2045 - 31-December-2045	8,167
01-January-2046 - 31-December-2046	8,413
01-January-2047 - 31-December-2047	8,150
Total Estimated ERs	211,484
Total number of crediting years	30
Average annual ERs	7,049

1.11 Description of the Project Activity

The Westphalen Forest Carbon Project is a conservation based IFM project which will generate GHG emission reductions by curtailing harvesting, road building, and other forestry related operations. The Project Proponent will implement the IFM project by converting commercial forests into conservation-based forests, thereby retaining, and increasing carbon retention and the avoidance of future GHG emissions from timber harvest operations.

Novel technologies, products, or services will not be required for project implementation. The Westphalen Forest Carbon Project will be implemented following logged to protected forest conservation principles. Emphasis will be placed on forest health monitoring, conservation research, and property lands supervision. Low levels of forest management activities for forest maintenance, ecological enhancement, and/or risk mitigation (for example, pest management, salvage, etc.) will occur during the project. These activities will demonstrate that they have a conservation benefit and are consistent with principles of managing for biodiversity, ecosystem function, carbon retention and/or are related to restoration, ecological management, or emissions risk reduction. Emissions that occur from forest health management activities will be tracked and accounted for in carbon projections.

The Project Proponent, Westphalen, will oversee the implementation of the project. To date, no other entities (i.e., groups, committees, communities) are directly involved in the implementation of the project. Other entities may be included in the future as an additional proponent as part of the grouped project.

The project is not located within a jurisdiction covered by a jurisdictional *REDD+* program.

1.12 Project Location

The Westphalen project area occupies 772 ha of privately owned German forest land. The project geographic area is composed of nine regions, each containing non-contiguous parcels which make up the current activity instance (see Appendix 8 for completed list of project area polygon co-ordinates). Six of the project regions are in central Germany, and three regions border the Baltic Sea on the north coast of the country. The surrounding areas are a mixture of privately owned operational forest lands, towns and communities, residential areas, farmland, and federal and state-owned lands. The extent of the PAI is described by the geodetic coordinates within the table titled “Project Geographic Boundary” below, map(s) within Section 3.3 and the provided KML file.

Table 7: Project Geographic Boundary

Extent Coordinates				
Coordinate System	North	South	East	West
GCS_WGS_84	55.058	47.270	15.037	5.866

The non-permanence risk assesses the geographic area specified in the project description as all internal and external risks are similar throughout the 9 administrative regions and the 8 forest ecosystem types described in section 1.12 and 1.13 respectively.

1.13 Conditions Prior to Project Initiation

Ecosystem Conditions

The PAI (which is comprised of multiple polygons [parcels]) includes a wide range of forest types located throughout northern and central Germany. Elevations range from low gradient rolling hillsides, to sub-alpine elevations.

Forest ecosystem types in Germany have been categorized as near natural or cultivated due to centuries of intensive forest management practices. Ecological types are classified based climatic locations, stand structure, soil nutrient, moisture, and ecological characteristics, as well as associated plant species. Ecosystem classification is a valuable tool used by forest land managers for site condition descriptions and influence land management practices. Ecosystem types found in the Westphalen Forest Carbon Project and their descriptions can be found in Table 8 (Identification Key of the Forest and Forest Ecosystem Types in Germany (Hofman 2017).

Project area soil conditions are regionally specific. Soils in northern project instances are formed on glacial drift areas (European Soil Bureau 1998). Soil types include Luvisols, Podzols, Gleysols, and Cabisols. Central Germany project instances are located on loess and sandy loess areas, and non-metamorphic sedimentary rock parent materials (European Soil Bureau 1998). Soils in this area include Luvisols, Chernozems, Gleysols, Leptosols, and Cambisols (European Soil Bureau 1998).

Climatic conditions within the project area are best described by the Dfb Köppen climate classification (Figure 1.). Annual average temperatures are approximately 10 C, and mean annual precipitation is 805mm which is evenly spread throughout the year.

Conditions prior to the initiation of the project are immaterial different from current forest conditions as illustrated in the various inventories and approved forest management plans.

Current and Historical Land-use

Conditions existing prior to the initiation of the Westphalen Forest Carbon Project are the same as the baseline scenario. Refer to Section 3.4 for a full description of the baseline scenario.

The geographical extent of the Westphalen Forest Carbon Project occurs across various regions in Germany and contributes to a range of pre-project site conditions. The land parcels included in the project instances have been historically managed for forestry harvest operations for decades under Westphalen. In addition to forest management, Westphalen implements agriculture operations as well as the planning and installations of wind, solar, and biogas powered facilities. The land within the project area has not been cleared of native ecosystems within 10-years of the project start date.

Table 8: Forest Ecosystem Types in Germany zones within the project

Ecosystem Type	Landform Distribution	Ecological Characteristics	Vegetation Type
Eb-5n-C2 Moder Spruce Forest	Distribution outside of the Alps below 850m elevation. Generally on even slopes	Occurs on terminal and ground moraine terrains. Tend to be homogeneous in stand and age and structure as it was created by forest economic activities. Occurs in sandy loam soils with medium soil nutrient and moisture levels. Historically a replacement of beech and oak forests.	Spruce dominant tree species associated with raspberry, blackberry, common Beech, and mountain ash shrub layers. Humus type moder. Good to medium growing forests.
Eb-5n-D1 Loam Brown Mull Beech Forest	Distribution in lowlands and the lower mountainous regions at elevations from sea level to 500m. Annual precipitation over 600mm.	Occurs on level to rolling slopes in loamy to sandy loamy soils. Soil nutrients are rich with moisture levels low to medium.	Mixed deciduous stands dominated by common beech. Associated with single-flowered pearl grass, golden nettle, millet grass, and wood violet. Humus layers are deep and considered mull.
Eb-7n-D1 Brown Mull Beech Forests	Distributed in lowlands to low mountainous regions at elevations from sea level to 500m. Annual precipitation below 600mm.	Occurs on level to rolling slopes in	Mixed deciduous forest, sycamore, European ash, and hornbeam, beech dominant.
Eg-5n-b1 Raw Humus Spruce Forest	Distribution throughout the lowlands.	Established on even slopes in poor sand soils. Moderately dry to medium fresh soil moisture content. Historically a replacement of beech and oak forests.	Spruce dominated tree species associated with blueberry and pill sedge. Humus type is very acidic and considered raw.
Eg-5n-C2 Raspberry Spruce Forest	Distribution throughout lowland sites.	Occurs on even slopes composed of sand, sand over clay soils that have a moderate to rich soil nutrient level. Historically a replacement of grove sims and millet beech forests.	Scots pine is the leading species in these multilayered stands. Associated with common beech, wood sorrel, and blueberry.

Ecosystem Type	Landform Distribution	Ecological Characteristics	Vegetation Type
			Humus layers considered modest
Eg-5n-C3 Calciphilous Spruce Forests	Distribution throughout lower mountains.	Occurs on level to rolling slopes composed of limestone loamy soils that are well drained and dry with low to medium levels of nutrients.	Primary species spruce, common beech, mountain ash. Associated with nettle, broad leaved thorn fern.
Eg-7g-E1 Mull Ash Hornbeam Forest	Distribution throughout the lowlands and valley regions.	Occurs in nutrient rich, loamy clay, colluvial clay soils that are considered damp.	Deciduous stands with Hornbeam being the dominant species. Occurs with sycamore and common ash. Associated shrub layer is hazel. Other plant species present are stinging nettle, yellow anemone, celanine, herbwort, lingwort, and wood squid. The humus layer is described as wet.
Eg-7u-T5	Distribution throughout the lowlands only. Elevations from sea level to 500m.	Occurs in valley bottom flood plains. Soils tend to be moderately acidic, rich, and are periodically flooded.	Deciduous stands with primary species being black alder mixed with sallow willow, and white elm. Occurrences with marsh pippau, brook avens, grove starwort, and stinging nettle. Humus base is semi peaty and wet.

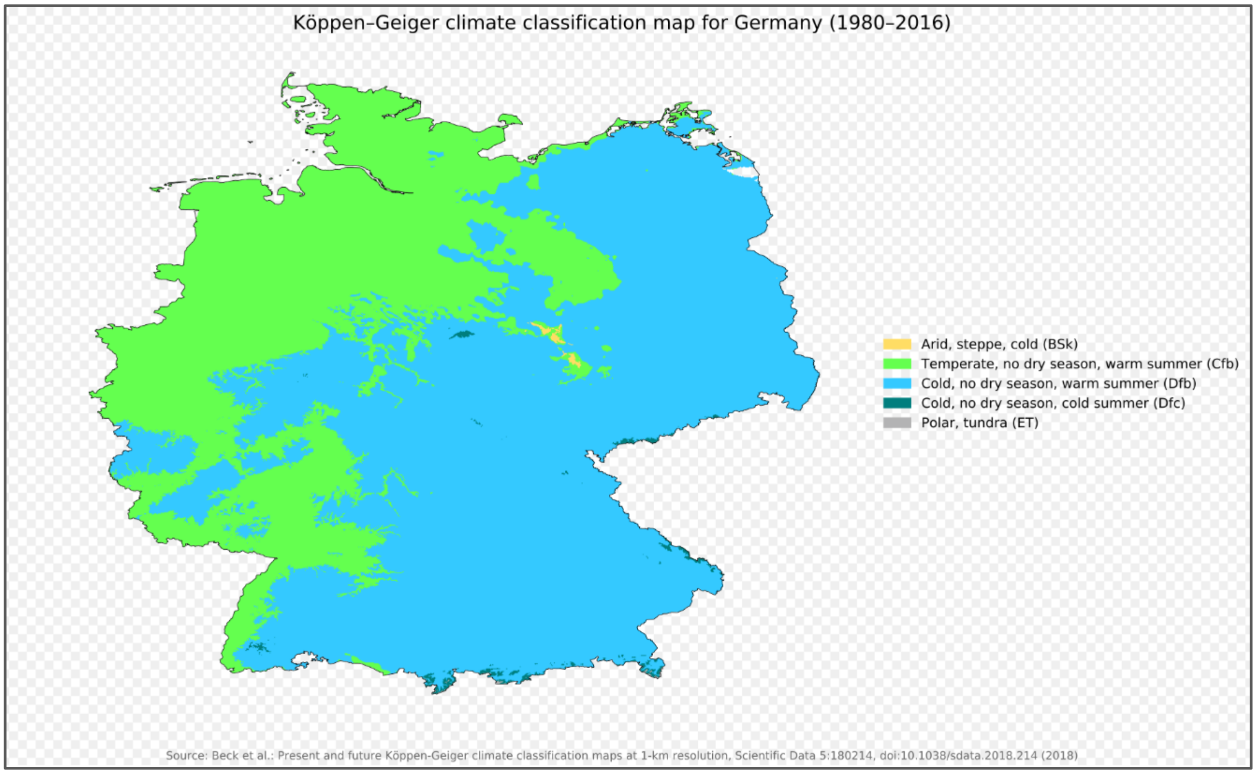

Figure 1: Köppen Climate Classification Map for Germany

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

In Germany, private landowners maintain the legal right to harvest timber from their lands, permitted by the German Constitution (Grundgesetz), German Civil Code (Bürgerliches Gesetzbuch), National Forest Act (Bundeswaldgesetze), and the Federal Nature Conservation Act (Bundesnaturschutzgesetz). German law dictates that forest owners manage their forest properly, sustainably, according to plan (compliance with laws and other regulatory frameworks is achieved through the development of the forest management plan and supporting harvesting documentation for forest landowners), and expertly for the benefit of the public in accordance with the principles of forestry and land conservation. Proper forest management utilizes economic methods that use, rejuvenate, maintain, and protect the forest according to reliable scientific findings and proven rules of practice, while maintaining the economic and ecological performance of the forest.

Concurrent with the German Basic Law and its provisions specific to present day forest governance, are the Federal Forest Act and State Forest Laws, presented in more detail in Table 9: Relevant Legislation Governing Private Forest Land Management.

Table 9: Relevant Legislation Governing Private Forest Land Management

Legislation	Description
German Basic Law	The German Basic Law provides fundamental governance relevant to the forest sector and its development. Fundamental provisions ensure that forest land ownership continues to be diverse and that tenure security for forest owners (German States, communal administrations, and private landowners) is provided. Sustainability and the protection of the natural foundations for life and animals with regards to future generations is principal. The unified framework of standards and conditions are observed in all German States on a federal level, but each State has accommodation to enact State laws reflective of their own unique circumstances.
Federal Forest Act	The Federal Forest Act provides a normative framework for sustainable forest management and a unified basis for public forest sector support. This Act is comprised of 5 chapters which outline general forest policy and provisions, aspects of forest preservation and sustainable management, legal categories of forest management and associations, public support and recurrent national forest inventories, and forest governance bodies empowered to enact provisions for the application of the Act.
The Law on Forest Reproductive Material	This Law regulates sources identified forest reproductive materials. To conserve and enhance forests, public approval is compulsory with strict restrictions in place regarding any seed genetic modifications, clone use, and nursery facilities. This Law works in cooperation with the European Union, and as such, the governance and documentation of material origins, mixture, labelling, and marketing and is stringently enforced.
The Law on Compensation of Extraordinary Forest Damages	This Law is an authoritarian law that enables governing bodies to limit annual domestic timber production and timber imports in the event of catastrophic events causing forest damages which result in non-localized market distortions. The purpose is to lessen economic impacts on forest enterprises through the application of fiscal privileges and rebates.
The Law on the Common Task of Improving Agricultural Structures and Coastal Protection	Statutory Laws covering the protection of and management of environmental provisions in regard to forestry operations.
The Federal Soil Protection Act	This Act is regulatory and its focus is on soil protection and restorations. Relevant authorities may restrict activities that have detrimental soil impacts, including forestry. The Act distinguishes between ecological, archaeological, and productive functions. Regarding forestry activities, this Act is supplemental to forest laws regarding due diligence in soil management.
The Federal Water Act	This Act provides regulations applicable to surface waters, coastal waters, and groundwater resources and serves to ensure their sustainable management. Applicability to forestry is the prohibition to transform natural swamp forest into other types, management restrictions of forests in designated water protection zones, as well as riparian buffers and felling operations.
The Federal Nature Conservation Act	The Federal Nature Conservation Act preserves biological diversity, ecosystems, and natural landscapes through sustainable management and conservation practices. Certain natural forests are preserved legally under this Act as protected biotypes.

Legislation	Description
State Forest Laws	State Forest Laws reflect the basic structure and main provisions of the Federal Forest Act. State Laws differ in terms of minimum requirements for forest operations, forest functions, protected areas, mandates, administrations and penal provisions.
NATURA 2000	Natura 2000 is European Union (EU) State legislation that protects birds, animals, and natural habitats through the Bird and Habitat Directives. It is a network of special areas of conservation, protection, and importance created to maintain and restore natural habitats, wild fauna, and flora in linked networks across the EU. It is a main driver for biodiversity and nature policies for countries in the EU but does not replace any legally required existing laws. Natura 2000 management plans created for forest lands are considered binding guidelines, not legal obligations.

1.14.1 Municipal Legislation

Lands within municipalities must guarantee the right to regulate all local affairs on their own responsibility, within the limits prescribed by the laws. This is in accordance with the German Basic Law. Project activities do not disobey any laws as outlined in Federal or State legislations or at the municipal level.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

This project has not been registered and is not seeking registration under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

This project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG related credit, including renewable energy certificates.

1.16.3 Supply Chain (Scope 3) Emissions

Westphalen is an individual domestic supplier of raw log materials within Germany and is not a wholesaler, distributor, or retailer of manufactured wood products.

Supply Chain Scope 3 Emissions are considered the largest source of GHG emissions for companies and can indirectly affect both upstream and downstream business activities throughout a supply chain. These emissions are generally more complex to measure and track as companies do not have direct control of other businesses, suppliers or organizations that are involved within the same supply chain.

The following list describes Scope 3 Emission categories as defined by the Greenhouse Gas Protocol[3]. The Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard was referenced to select the applicable upstream and downstream categories which may be impacted by the Westphalen Forest Carbon Project.

Table 10 : Upstream and Downstream Supply Chain Catagorized Activities

Upstream Activities (Indirect Supply Chain Emissions)	Applicability	Downstream Activities (Indirect Supply Chain Emissions)	Applicability
1) Purchased Goods and Services	Applicable	9.) Transportation & Distribution	N/A
2) Capital Goods	Applicable	10.) Processing of Sold Products	N/A
3) Fuel and Energy Related	N/A	11.) Use of Sold Products	N/A
4) Transportation and Distribution	Applicable	12.) End of Life Treatment of Sold Products	N/A
5) Waste Generated in Operations	N/A	13.) Leased Assets	N/A
6) Business Travel	Applicable	14.) Franchises	N/A
7) Employee Commuting	Applicable	15.) Investments	N/A
8) Leased Assets	Applicable		

*Scope 3 emission reporting is not a legal requirement for Westphalen

The Westphalen Forest Carbon Project area supplies round wood and fuel wood to 31 manufacturing and sawmill companies and is involved in all activities related to maintaining forest stand health and maintenance. A public statement regarding Scope 3 emissions has been demonstrated by Westphalen

[3] The Greenhouse Gas Protocol is the globally recognized standard for measuring and mitigating GHG emissions in both private and public business sectors. For more information see: https://ghgprotocol.org/about-us

via the company website and emails have been sent to current retailers regarding the project describing the potential risk of double claiming. See Appendix 7 and website link[4] for substantiation.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The Westphalen Forest Carbon Project will contribute to sustainable development as defined by and tracked against the United Nations Sustainable Development Goals (SDGs). Westphalen's contribution to (at minimum) SDGs 12 (Responsible Consumption and Production), 13 (Climate Action) and 15 (Life on Land) is illustrated through the following activity initiatives: Through mitigation actions and change activities, the below initiatives both support and further develop the project SDG goals and their associated targets.

Project Activity	Description	SDG Targets
Group Activity 1 – Forest Resource Maintenance & Ecosystem Biodiversity Initiative	This initiative relates to on-going implementation, maintenance, and certification to a recognized third-party forest certification standard on privately owned forestlands. The certification requires measures to be implemented to protect water quality, biodiversity, wildlife habitat, species at risk and forests with exceptional conservation value. This sustainable forest management certification requires on-going monitoring, reporting and annual external audits by accredited third parties.	 
Group Activity 2 - Climate Improvement Initiative	As outlined in this Project Description Document, Westphalen intends to implement a carbon offset project to create greenhouse gas (GHG) emission reductions and removals by converting privately owned operational forest lands to protected forest lands. By stopping timber harvest within the PAIs, an estimated 220,000 tonnes of carbon dioxide equivalent (tCO_2e) will be reduced from the atmosphere during the life of the project. This project requires on-going monitoring, as well as validation/verification audits by accredited third parties.	

In 2021 the German Government released the newest version of Germany's Sustainable Development Strategy. The German Government is committed to multilateral approaches and actions to the implementation of the United Nations 2030 Agenda, specifically in relation to the 17 Sustainable Development Goals. Currently the Strategy now contains 75 indicators and targets 39 areas linked to 2030 Agenda goals. Indicators and actions are being specifically targeted toward Federal Government

[4] Westphalen website: News - Graf von Westphalen (graf-von-westphalen.de)

participation at International, European, and National levels. At this time as a private landowner, Westphalen is not required to report or monitor on any nationally stated SDG targets and indicators.

1.17.2 Sustainable Development Contributions Activity Monitoring

The Westphalen Forest Carbon Project during this monitoring period results in contributions and benefits by providing climate improvement through the reduction and removal of GHGs with the implementation of a LtPF, sustainable forest management practices, and by providing plant and wildlife biodiversity through ecosystem management and conservation.

Table 11: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	12.2	Responsible Consumption + Production: Achieve the sustainable management and efficient use of natural resources.	Implemented activities to decrease	Sustainable forest management practices implemented and consistent with long term modeling and management plans.	Forestland is certified to a recognized third-party sustainable management standard
2)	13.0	Climate Action: Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to decrease	By conserving 772 ha of temperate boreal forest, the Westphalen Forest Carbon Project has prevented the release of 16,114 tonnes of carbon into the atmosphere during the monitoring period	Prevent the release of an estimated 211,484 tonnes of carbon into the atmosphere

3)	15.2	Life on Land: Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Implemented activities to increase	By conserving 772 ha of tropical rainforest, the Westphalen Forest Carbon Project has protected the ecosystems and biodiversity for fauna and wildlife	Prevented the deforestation of 772 ha of private forestlands, contributing globally

1.18 Additional Information Relevant to the Project

Leakage Management

Westphalen will provide evidence that no compensatory harvesting has been initiated to account for lost timber volumes incurred during the carbon project. Supporting evidence may include financial statements or harvest volume summaries to show that no additional land acquisition will be made with the sole intention of replacing harvest which has been curtailed through the creation of the Westphalen Forest Carbon Project.

Further information regarding a leakage monitoring plan will be provided within Section 6.3.1.

Commercially Sensitive Information

Commercially sensitive information has been excluded from the public version of the project description document.

The detailed Net Present Value (NPV) analysis data is commercially sensitive, however, sufficient detail is provided for baseline scenario determination and demonstration of additionality.

The VVB and Verra have been provided with this detailed information at the time of validation and at subsequent verification events.

Further Information

No further information beyond what has been provided within the sections of this project description document has bearing on the eligibility of the project, the net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

There are no known or anticipated potential negative environmental and socio-economic impacts related to the Westphalen Forest Carbon Project, specifically due to the nature of the project being the retention of natural forests. Following the procedures described within the Zimmfor Management Services Ltd., Greenhouse Gas – Stakeholder Consultation + Engagement (SOP) a Life Cycle and Aspects analysis was conducted. Refer to Section 2.5 below for a full description of this process.

2.2 Local Stakeholder Consultation

Local stakeholder consultation was conducted for a 30-day period between October 4, 2022, and November 3, 2022, prior to project validation. Consultation was conducted via electronic documents delivered by email, and in-person open house meetings held in Germany on October 7, 2022, and on October 13, 2022. The meeting was chaired by Dr. Johannes Gerst, the lead forester for Westphalen. Attendance was taken at local stakeholder meetings and is kept on file.

Stakeholder information relating to the project design and implementation, results of monitoring, any risks, costs or benefits to local stakeholders, all relevant law and regulations covering workers' rights in Germany, and the validation and verification process was provided via the Zimmfor website, Zimmfor.com. Links to the Verra Project Registry are also provided on the Zimmfor website. If required throughout the life of the project, any additional information that is required to be communicated to local stakeholders will follow the same process of electronic correspondence via email and information provided via the Zimmfor website.

An online form was made available on the Zimmfor website and was used to collect stakeholder comments and feedback. If there are responses using this form they are automatically entered into a Consultation Database managed by Zimmfor. This form will remain accessible to the public throughout the lifetime of the project, allowing for continual stakeholder engagement.

All public comments, if received through the online comment form are recorded within the Consultation Database. Responses and any required project design updates to the project design relating to comments received from Stakeholders were also tracked within the Consultation Database. The Consultation Database will be made available to the VVB during project Validation and Verification. Refer to the Zimmfor GHG -Safeguards SOP for additional details relating to Stakeholder consultation processes.

To date, no comments have been received through the local stakeholder consultation process as outlined above. For further clarity see the section entitled 'Public Comments' for comments received during the Verra comment period.

2.3 Environmental Impact

An Environmental Impact Assessment was not required for the Westphalen Forest Carbon Project.

2.4 Public Comments

The Westphalen Forest Carbon Project Listing Document (V1.0) was listed on the Verra Project Registry for public comment on July 28, 2022, through to August 27, 2022. Four comments were received by Zimmfor from interested members of the public.

Due account of all public comments received was completed by Zimmfor (refer to table below). Each comment was evaluated for its relevance to project design considerations.[5] The comments that were received and the responses/actions taken are also noted in the table below.

Comment 2022-VPC-01c resulted in the clarification within the PD/MR of the project proponent's intent to maintain the project for 100 years. Comment 2022 VPC-04 resulted in a clarification being added to PD/MR noting that final felling may occur (when prescribed by the approved forest management plan).

Comments received	Response/ Actions taken
2022-VPC-01a How was the area used before the project started?	Project activity instances area were used for commercial forestry activities prior to project implementation.
2022-VPC-01b Was it an area that was subject to intensive forest management before?	Definition of "Intensive Forest Management" may be subjective with no known consensus on definition. The forests are being managed consistent the third-party sustainable forest management standard title the "Programme for the Endorsement of Forest Certification".
2022-VPC-01c What happens to the area after the end of the crediting period of 30 years, is it guaranteed that the area remains declared as a conservation area?	The project proponent may choose to continue the carbon project; as per VCS VM0012, the project activity instances are not considered conservation areas. *UPDATE: PD/MR updated to clarify intent to maintain the project for 100 years. Clarification communicated to Verra Secretariate.*
2022-VPC-01d Since which year has the area been taken out of use?	Improvement Forest Management (IFM) activities consistent with the VCS VM0012 methodology were implemented January 1, 2018.
2022-VPC-01e When was the last harvest, timber extraction?	Minor timber (with commercial value) was harvested from the project activity instances in July 2021.

[5] Project Design considerations included Project Area, Project Owners/Proponents, Project Activity, Project Crediting Period, Project Longevity, Project Risk and Methodology.

2022-VPC-02 It should be shown and ensured by the project developer that it is not an area that was previously subject to intensive forestry management, which receives interim financing for 30 years through the voluntary CO2 market, and then returns to its original forestry use through the designation as a conservation area and after the end of the crediting period.	Refer to response associated with 2022-VPC-01c.
2022-VPC-03 The project developer refers to carbon emission offsets in 1.1 Summary Description of the Project. It is of public interest to understand VERRA's position regarding offset claims in Germany?	The project developer has no knowledge of Verra's position regarding offset claims in Germany. Refer to: Media Statements – Verra
2022-VPC-04 In Germany, clearcutting is generally prohibited by law or allowed only in certain cases. Can you explain this in more detail? Why did you choose to model the baseline scenario with clearcutting as one of the main commercial activities, even though this is not necessarily the standard approach in this jurisdiction.	Westphalen forest management activities are conducted consistent with the relevant legislation referenced in Table 6 of the PDD. Conformance to this legislation is validated via audits conducted by accredited third-parties. The baseline was modelled consistent with current "business as usual" forest management activities. The term "clearcutting" may not be the most appropriate term to describe the management activities included within the baseline. Term to be revised to "final felling", or equivalent. Action completed – update Project Description and Monitoring Report.

2.5 AFOLU-Specific Safeguards

Refer to the Zimmfor GHG – Stakeholder Consultation + Engagement SOP for details relating to the process used to determine local stakeholder identification. Additionally, the SOP outlines the Life Cycle and Aspect Analyses used to determine risks to local stakeholders and their resources.

Potential stakeholders were identified by the project proponent. The proponent provided a categorized description of people potentially impacted by the project. Stakeholder contacts were chosen to:

- Cover national, county, and smaller scale levels,
- Provide a range of stakeholder organization sizes, from larger institutions through to small organizations and individuals,

- Provide a range in geographic coverage, with a focus on areas where forest management is likely a priority.

Information was collected with the goal to:

- Identify digital contact information (i.e., email addresses), as the primary point of contact (to maximize the duration of consultation, to speed up the response process, and to facilitate responses and information sharing, and
- Provide a sufficient number of contacts, commensurate within available information and the size of the project area.

Once potential stakeholders were identified, they were categorized as follows to ensure adequate representation had been achieved across the following groups. There were no stakeholders that were identified as having rights to resources of the land associated with the project activities.

1. Economic
    - Other Forest Owners (adjacent to the project area)
    - Forest Contractors
    - Representatives of Forestry Workers/Industry
2. Social
    - Non-government organizations
    - Households and community members
    - Local government
    - Recreation Representatives
3. Environmental
    - Non-government organizations
    - Local Communities

Table 12. Number of stakeholders identified by stakeholder group

Stakeholder Group	Number of Stakeholders Identified
Economic	79
Environmental	75
Social	113
Total:	267

The project area is non-contiguous, privately owned, and accessible by forestry roads. There are no communities or other ongoing public use for income or livelihood by any people living, or who are dependent on resources, within the PAI that would be affected by the project activities. The region has a well-developed industrial and communication infrastructure, a strong agriculture and tourism industry, and a wide range of skilled laborers within a diverse economy.

The group of stakeholders identified for the Westphalen Forest Carbon Project were inclusive of the following organizations (see Table: Stakeholder descriptions by stakeholder group). Representatives for the group's stakeholders identified ranged in gender, age, and ethnicity. As defined by the United Nations, Indigenous Peoples are those that "have retained social, cultural, economic, and political characteristics that are distinct from the those of dominant societies in which they live[6]." Germany is home to inhabitants that have centuries of cohabitation and settlement history which has resulted in an ethnical group majority with equal rights, therefore no such people are classified or identify as indigenous in Germany.

For privacy reasons, stakeholder names (including names of organizations) are not named within this project document, however, will be provided to the VVB at the time of validation and all subsequent verifications.

Table 13 Stakeholder descriptions by stakeholder group

Stakeholder Group	Stakeholder Descriptions
Economic	Entrepreneur Forestry Representative Tree Nursery Wood Buyer
Environmental	Entrepreneur Official Nature Conservancy Volunteer Nature Conservancy
Social	Political Representative Adjacent Neighbour Agricultural Representative Hunting Officials Mayor Natural Park Works Council

[6] https://www.un.org/development/desa/indigenouspeoples/about-us.html

Interactions between the identified stakeholders are typical to those of the forest industry within Germany. Westphalen has relationships with adjacent neighbors, communities, and hunting officials to maintain access for recreational purposes as well as manage and provide access for firewood collection and hunting. Economic relationships extend to stakeholders such as wood buyers, forest contractors, and tree nurseries for purposes relating to the harvesting of wood products from lands owned by Westphalen. Westphalen has additional relationships with environmental stakeholders to ensure their management practices on their forest lands are up to date with all current environmental standards and best practices. These are just some examples of how the identified stakeholders interact with the project proponent.

Table 14 Aspects Analysis Results below, outlines the identified aspects, impacts, potential risks, risk category (based on Table 1 within the Zimmfor SOP), risk ranking (based on the Risk Ranking Matrix within the Zimmfor SOP) and mitigation measures applied (if any) related to the identified stakeholders.

Table 14 Aspects Analysis Results

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (implemented by project proponent)
Halting/ reduction of harvesting activities: Logged to Protected Forest (LtPF),	Reduced/no requirement for harvesting labor	Loss of income/ livelihood	Loss of income to local communities could result in the degradation of local communities (i.e., reduction in community resources, loss of community members due to moving, etc.). (Social, Economic)	Social/ Socio economic	**Low** – Project Proponent will not be halting all operations, only a portion of operations within the project area	Project Proponent will continue to offer employment opportunities on the remainder of their forest lands.
	Reduction/ no requirement for energy (fuel) consumption	Loss of income/ livelihood	Loss of income to the local economy due to reduced need for fuel. (Social, Economic)	Social/ Socio economic	**Low** – Project Proponent will not be halting all operations, only a portion of operations within the project area	
	Reduction of fuelwood produced	Loss of wood for heating/ fuel purposes	Loss of access to fuel source for home heating (Social, Economic)	Social/ Socio economic	**Low** – Continued harvests in areas intended to produce fuelwood for local communities.	
	Public Access reduced or denied	Public recreation opportunities	Increase in illegal trespass instances. Reduced public health (mental and physical)	Social/ Socio economic Traditional/ Human Rights	**Low** – Public access will not be reduced in project scenario	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (implemented by project proponent)
		reduced or denied	due to reduced access to recreation (Social, Economic)			
	Public access for foraging/ hunting purposes reduced or denied	Increase in illegal trespass instances. Reduced access to food sources	Increase in illegal trespass instances. Reduced access to food sources (Social, Economic)	Social	**Low** – Public access will not be reduced in project scenario	
	Public Access reduced or denied	Public recreation opportunities reduced or denied	Increase in illegal trespassing instances. Reduced public health (mental and physical) (Social, Economic)	Social/ Socio economic Traditional/ Human Rights	**Low** – Public access will not be reduced in project scenario	
	Public access for foraging/ hunting purposes reduced or denied	Increase in illegal trespassing instances. Reduced access to food sources (Social, Economic)	Increase in illegal trespassing instances. Reduced access to food sources (Social, Economic)	Social	**Low** – Public access will not be reduced in project scenario	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (implemented by project proponent)
	Reduction in harvesting/ controlled burns for purposes of fire prevention	Increase risk of forest fire	Local communities are exposed to higher risk of forest fire. Adjacent forest owners are at risk of commodity loss due to fire spread. (Social, Economic, Environmental).	Environmental	Low – Project Proponent utilizes intensive silviculture measures, i.e. thinning, sanitation cuts. Fire hazard assessments will continue to be conducted in areas where annual monitoring is conducted	
	Complete termination of project area maintenance	Pest or Disease Outbreak	Spread of disease to local community forests/ adjacent forest lands. Watershed/ water quality degradation due to transition to low productivity stands (Social, Economic, Environmental)	Environmental	**Low** – annual monitoring along with continual pest management within project area will continue to occur.	
		Public safety	Increase in accident or injury within project area accessible to public (Social)	Social/ Socio - economic	**Low** – public access will not change due to the project scenario	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (implemented by project proponent)
	Property rights are undefined/ disputed	Loss of property rights	Project encroaches on private property Project encroaches on government property Project relocates people off their lands (Social, Economic)	Legal Social/ Socio economic	N/A – Project Proponent property rights have been verified and are not disputed	Additional measures: refer to Respect for Local Stakeholder Resources: Property Rights (GHG Safeguards SOP)
	Participation in project design, implementation, and/or consultation	Safety of local stakeholders	Increased risk to stakeholder safety due to opposing opinions, cultural/ religious differences, land holder grievances or disputes, government, or local oppression of freedom of expression. (Social)	Social/ Socio economic	**Low** – Refer to Universal Control; There is no evidence of the suppression of freedom of speech within Germany.	Universal Control = All stakeholder contact information (Name, Address, etc.) will be kept confidential. Stakeholder responses will be number coded as to keep public record of responses anonymous.

2.5.1 Grievance Redress Procedure

Zimmfor has developed a Grievance Redress procedure which is outlined within Stakeholder Consultation + Engagement SOP. Similar to the process for Stakeholder Consultation, the Grievance Procedures as well as a Grievance Submission Form are posted on the Zimmfor website. All grievances submitted to Zimmfor will be tracked utilizing the Grievance Record Database.

The following processes are intended to facilitate receiving, hearing, responding to and attempting to resolve grievances, within a reasonable time period related to VCS and SD VISta projects developed by Zimmfor. These procedures are to be applied to all Zimmfor VCS and SD VISta projects, however where appropriate, these procedures will be amended to take into account culturally appropriate conflict resolution methods.

These documented procedures, and documentation of disputes resolved through this procedure is made publicly available on the Zimmfor website (https://www.zimmfor.com/).

Contact Information

All grievances are requested to be submitted through the Grievance Submission form located on the Zimmfor website. Where local customs or circumstances do not allow for electronic submission, a paper version of the Grievance Submission Form can be provided. Please contact Zimmfor using the information provided on contact page of our website if you or someone you are representing requires an alternate form of submission.

Grievance Process

Stage 1 – Receive, Respond and Resolve

When Zimmfor receives a grievance related to a VCS Project, either directly or via a project proponent, Zimmfor will:

1. Acknowledge the grievance to the grievor, if not already done so by the project proponent and provide an initial response to the grievor within two weeks of the original grievance. Zimmfor will request the grievor complete the Zimmfor Grievance Submission Form if they have not already and including relevant evidence to support their concern. General information grievances received will be tracked within the Zimmfor Grievance Record Database and made publicly available.
2. Conduct a preliminary assessment to determine whether evidence provided in a grievance is or is not substantial, by assessing the evidence provided.
3. Dialogue with grievor with the aim to solve grievances assessed as substantial before further actions are taken.
4. While substantial grievances are pending, a precautionary approach towards the continued implementation of the project will be taken, which may include:
    a. Temporarily halting the sale of VCUs generated by the project, or

  b. Developing interim mitigation measures to effectively mitigate the grievance, until the grievance is resolved.

5. Where further investigation is required to resolve a substantial grievance, a desk or field review (as applicable) will be conducted within two months of the initial grievance.
6. Where a grievance is assessed as being substantial, mitigation measures will be developed, as applicable (e.g., mitigation measure revision or development, changes to project design or implementation). Mitigation measures may include steps to be taken by stakeholders, as well as the project proponent, to resolve the issue.
7. If a mitigation measure cannot be determined and/or enforced, Stage 2 – Mediation, shall be considered and managed accordingly.
8. Upon conclusion of the grievance review and mitigation process, the Grievance Record Database will be updated with relevant results of the grievance and any actions taken towards its resolution.
9. A separate grievance file will be maintained by Zimmfor to record detailed records of grievances received, correspondence, and actions taken.

<u>Stage 2 – Mediation</u>

If a grievance cannot be resolved by utilizing the procedure outlined within Stage 1, the grievance will be referred for a neutral third-party4 for mediation.

Procedures for mediation will be developed and outlined by the neutral third-party.

<u>Stage 3 – Arbitration or Adjudication</u>

Any grievances that are not resolved through mediation will:

1. Be referred to arbitration, to the extent allowed by the laws of the relevant jurisdiction, or,
2. Be referred to competent courts in the relevant jurisdiction, without prejudice to a party's ability to submit the grievance to a competent supranational adjudicatory body, if any.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The VM0012 Improved Forest Management in Temperate and Boreal forests (LtPF) v1.2 methodology has been selected for project implementation. Additional tools utilized include:

1. AFOLU Non-Permanence Risk Tool: VCS Version 4 (Procedural Document, 19 September 2019)
   - Justification: No additional application conditions are required through the use of this tool.
2. VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry, and Other Land Use (AFOLU) Project Activities – Version 3.0, Sectoral Scope 14.

As per section 1.2 this tool is applicable under the following conditions: AFOLU activities are the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced.

- Justification: The project activities do not violate any legislation applicable in Germany foreign or domestic.

The use of this tool to determine additionality requires the baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.

- Justification: Section 3.5, below, provides a stepwise approach to determination of the most plausible baseline scenario.

3.2 Applicability of Methodology

Table 15 Compliance with VM0012 Methodology Criteria

	Summarized Methodology Applicability Criteria	Westphalen Forest Carbon Project Fit
1.	Project meets criteria for IFM-LtPF projects	Westphalen meets specified criteria through the voluntary protection of privately owned forest lands within the project area. Refer to Section 1.3 (bullets 1 – 2) for how the project meets all requirements of a VCS IFM-LtPF activity.
2.	Project is located in Temperate or Boreal Domain Global Ecological Zones and meet Tier III inventory and data requirements	The Westphalen Forest Carbon Project is located in the Temperate Ecological Zone (Refer to Appendix 10) Westphalen utilizes detailed site level inventory meeting Tier III criteria.
3.	Project meets VCS Standard requirements for ownership	Westphalen can demonstrate Proof of Right and Right of Use (Refer to Section 1.7 Ownership)
4.	Annual illegal, unplanned and fuelwood removals are <5% of total annual harvest levels	The Westphalen Forest Carbon Project has no illegal or unplanned harvesting and, de-minimis fuelwood removals.
5.	No managed peatland forests in project	The Westphalen Forest Carbon Project areas do not contain managed peatland forests (Refer to Appendix 9).
6.	Total percentage of wetlands in project area not expected to change due to project activities	Westphalen will not materially alter the percentage of wetlands on the project area as the current PAI does not contain any wetlands.

	Summarized Methodology Applicability Criteria	Westphalen Forest Carbon Project Fit
7.	No activity shifting leakage to other Westphalen lands at the start of the project	Westphalen can demonstrate that baseline activities are not being shifted to other conservation land holdings. Refer for Section 7.4 for determination of no Activity Shifting Leakage.
8.	Project does not include non-de minimis application of fertilizer in the project scenario	Westphalen will not include any application of fertilizer in the project area.

3.3 Project Boundary

Table 16 Westphalen Forest Carbon Project Sources, Sinks, and Reservoirs

Source		Gas	Included?	Justification/Explanation
Baseline	Fuel Combustion by Vehicles/Equipment	CO_2	Yes	Source – Carbon emissions from harvesting equipment, log transport, and primary forest product manufacturing are listed as being an optional inclusion within VM0012 and will be included in the Westphalen Forest Carbon Project.
	Above Ground Biomass (Live)	CO_2	Yes	Sink – Biomass re-growth after harvest disturbance. Source – Carbon flows resulting from timber harvest removals and adjacent biomass impacts during operations (shifted to other carbon pools). Source – Emissions from mortality and decay in remaining forests.
	Below Ground Biomass Pool (Live and Dead)	CO_2	Yes	Sink – Biomass re-growth after forest management activities. Source – Carbon flows resulting from forest management harvesting removals (shifting to other carbon pools). Source – Emissions from mortality and decay in remaining forests (shifted to other carbon pools).
	Dead Wood Pool	CO_2	Yes	Sink – Dead snags, coarse branches, and stems before and after forest management activities. Source – Decay of deadwood pool.
	Wood Products Pool	CO_2	Yes	Sink – Carbon in permanent storage in harvested wood products. Source – Emissions from decaying wood products.

Source		Gas	Included?	Justification/Explanation
Project	Fuel Combustion by Vehicles/Equipment	CO_2	Yes	Source – Carbon emissions from industrial equipment are expected to be minimal due to low levels of conservation harvesting for forest health maintenance.
	Above Ground Biomass (Live)	CO_2	Yes	Sink – Biomass re-growth after harvest disturbance. Source – Carbon flows resulting from timber harvest removals and adjacent biomass impacts during operations (shifted to other carbon pools). Source – Emissions from mortality and decay in remaining forests.
	Below Ground Biomass Pool (Live and Dead)	CO_2	Yes	Sink – Biomass re-growth after forest management activities. Source – Carbon flows resulting from forest management harvesting. removals (shifting to other carbon pools). Source – Emissions from mortality and decay in remaining forests (shifted to other carbon pools).
	Dead Wood Pool	CO_2	Yes	Sink – Dead snags, coarse branches, and stems before and after forest management activities. Source – Decay of deadwood pool.
	Wood Products Pool	CO_2	Yes	Sink – Carbon in permanent storage in harvested wood products. Source – Emissions from decaying wood products.
Sources Excluded from the Baseline and Project Scenarios				
Excluded	Above-ground Non-Tree Biomass (Live)	CO_2	No	Sources and sinks are *de minimus.*
	Litter Pool	CO_2	No	Litter is a short-lived transition pool, and differences between the project and baseline are *de minimus* over time.
	Soil Carbon Pool	CO_2	No	Soil carbon is a reservoir of long-lived carbon storage which is likely unaffected by timber harvesting.

Refer to the project location maps, located below.

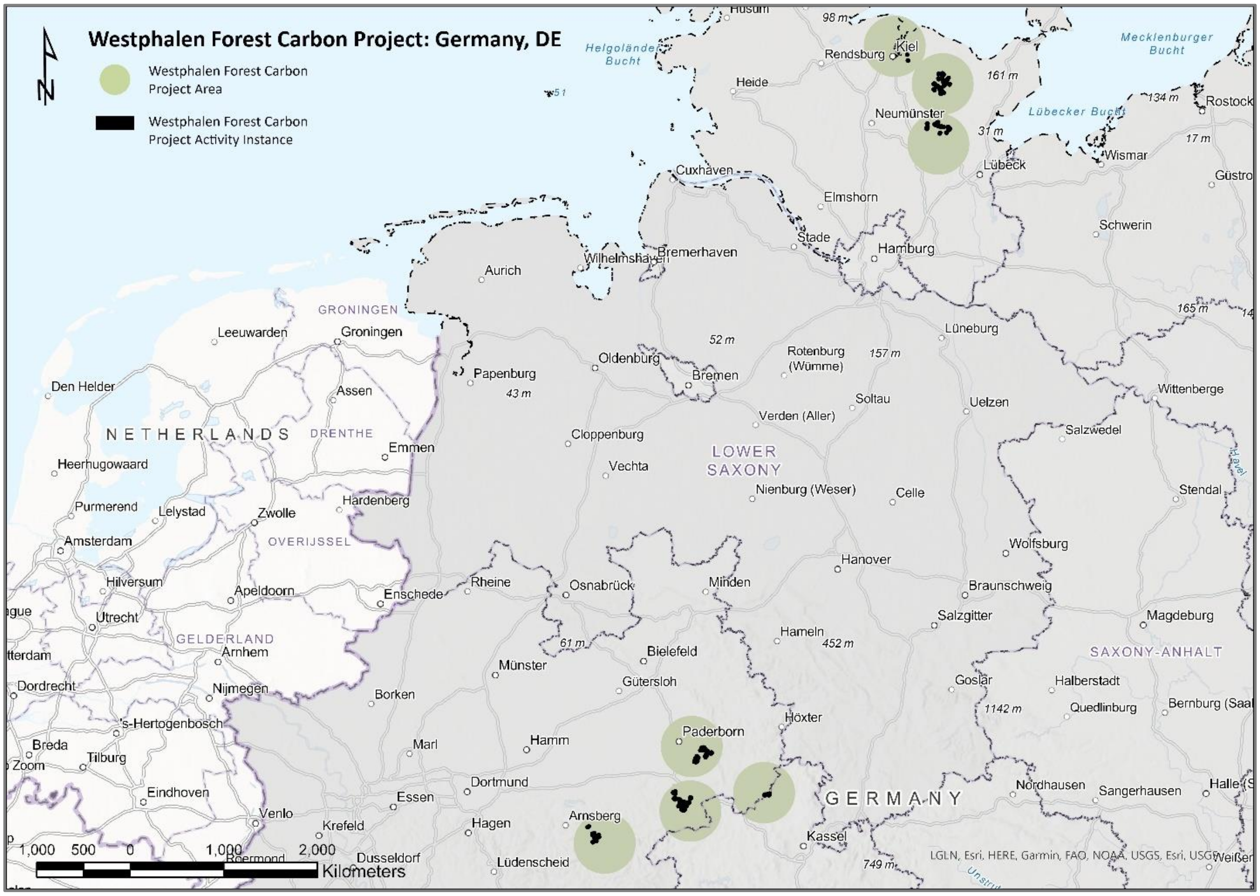

Figure 2: Overview of the Westphalen Forest Carbon Project Area

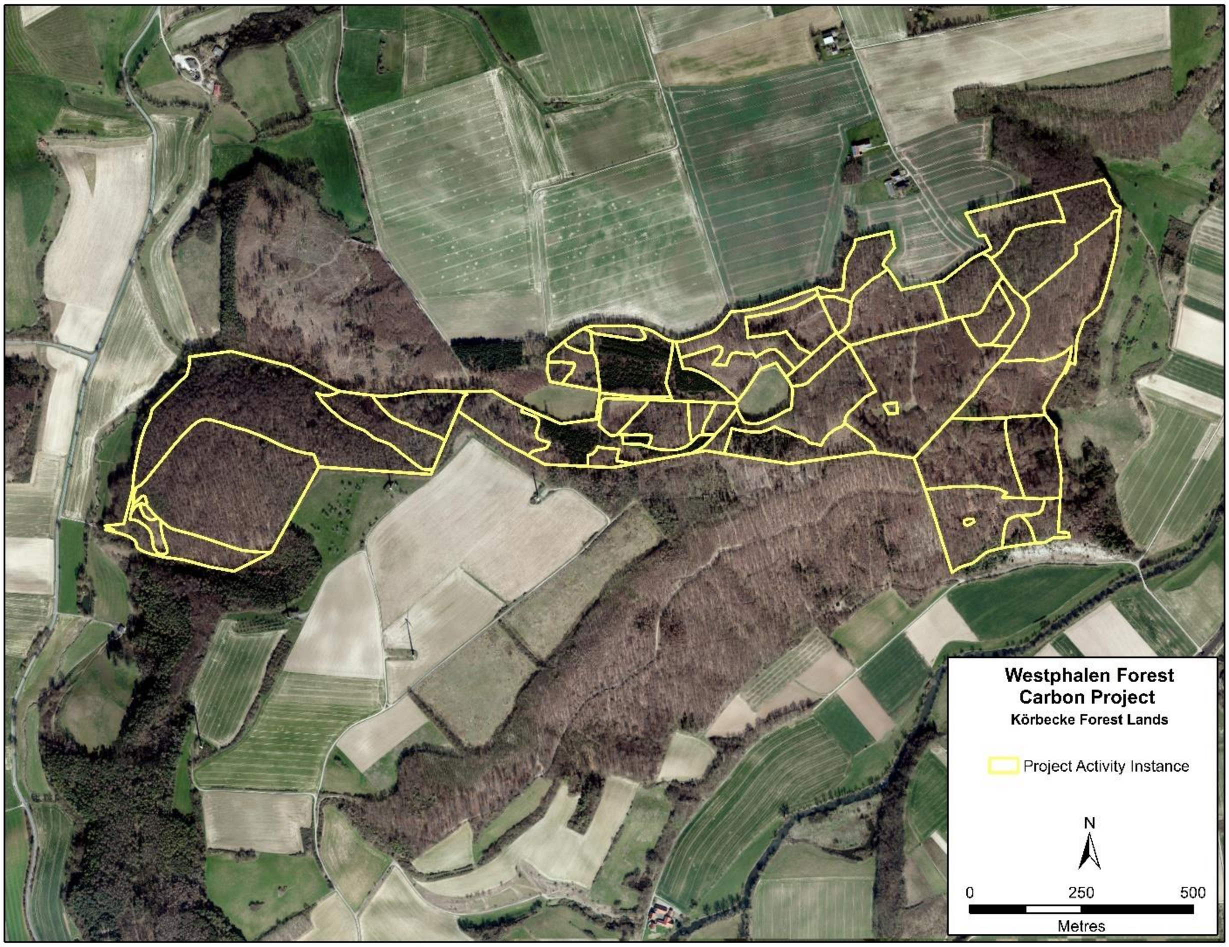

Figure 3: Detailed View of Körbecke Forest Lands

Figure 4 : Detailed View of Hirse Forest Lands

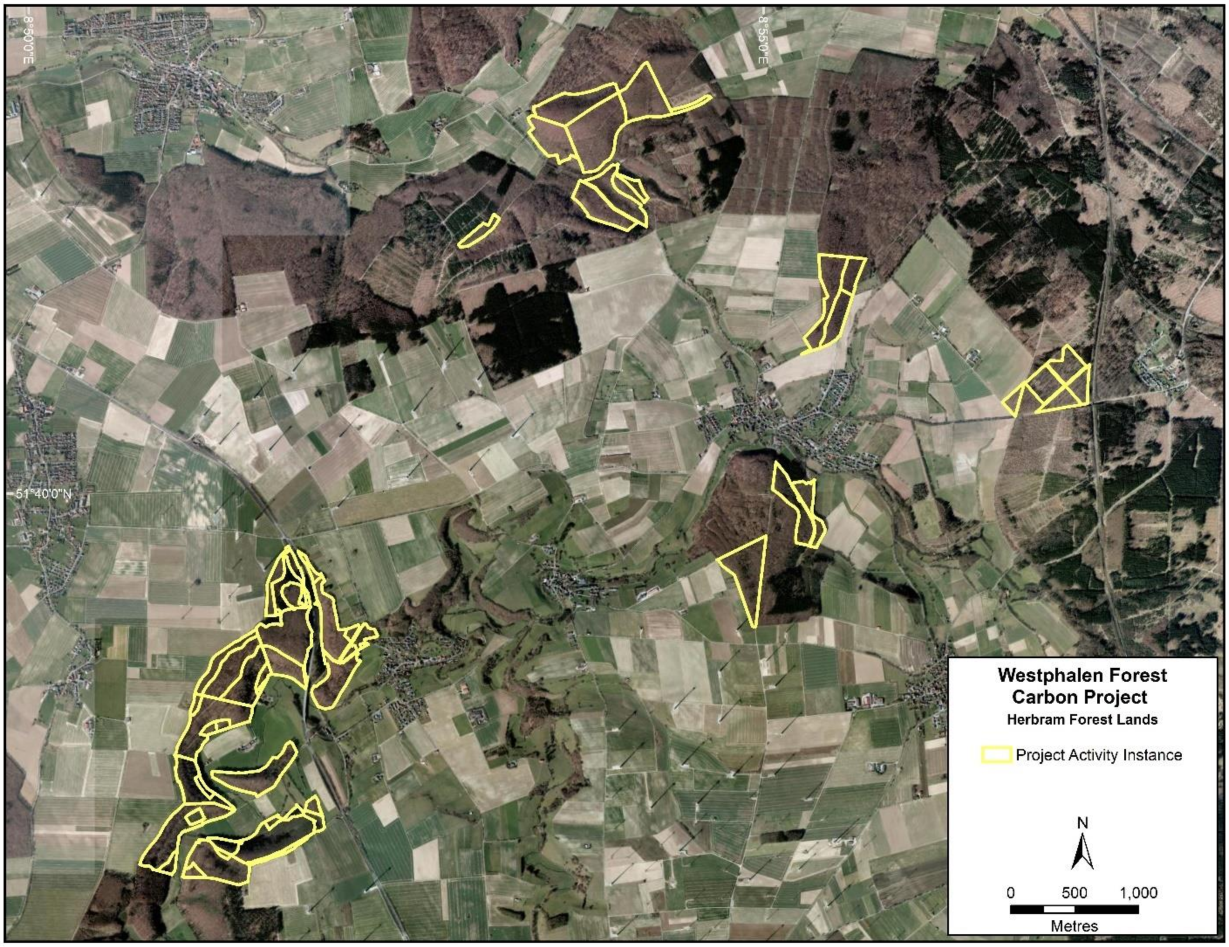

Figure 5: Detailed View of Herbram Forest Lands

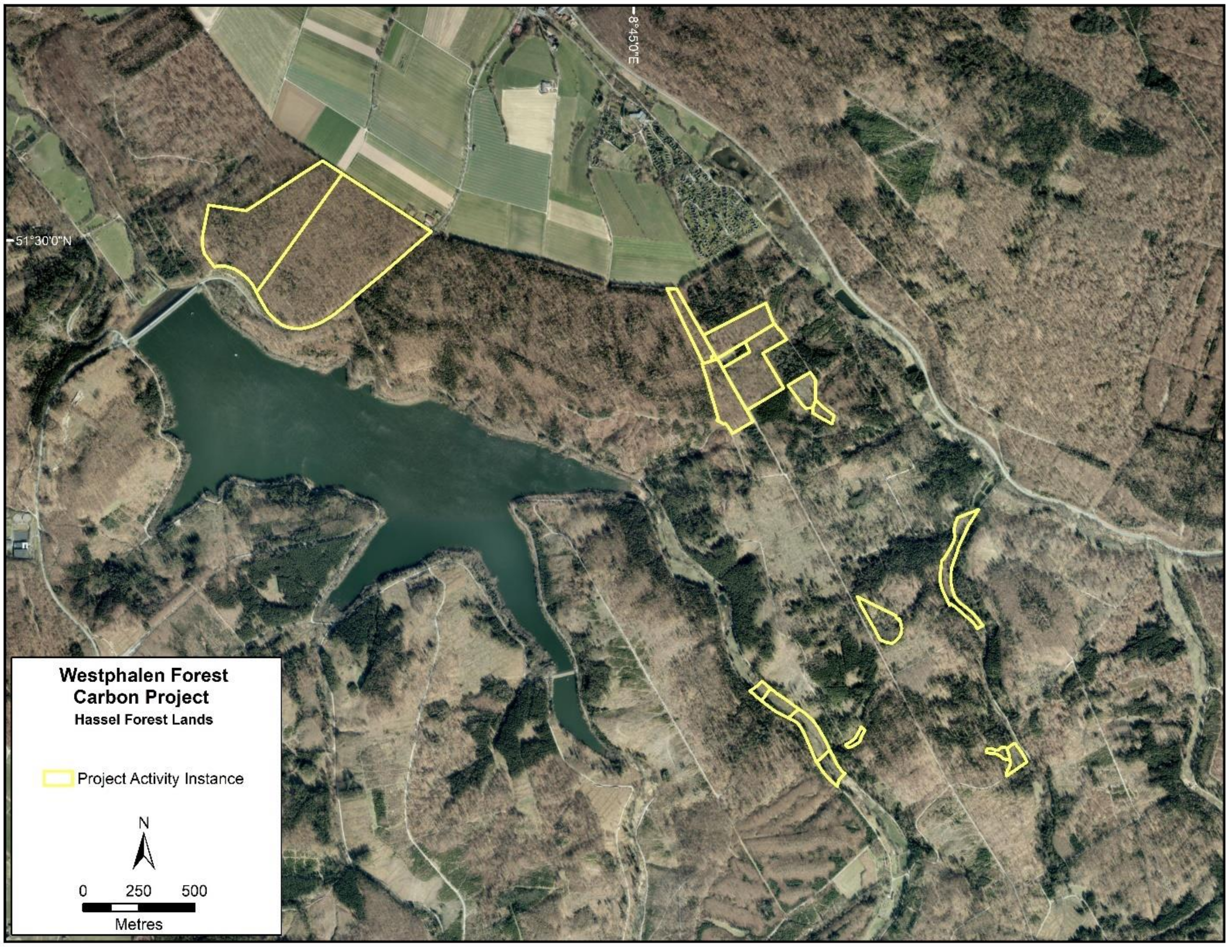

Figure 6: Detailed View of Hassel Forest Lands

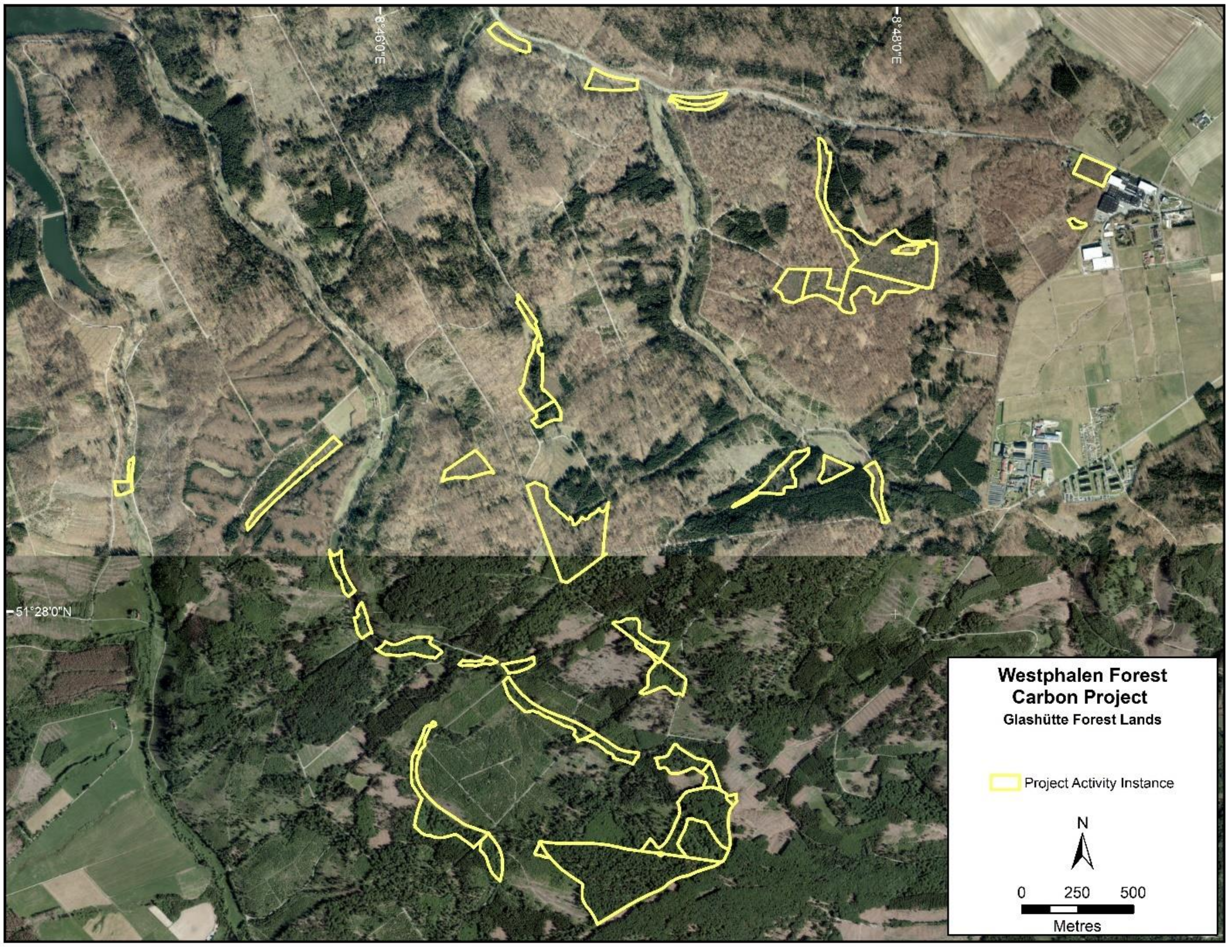

Figure 7: Detailed View of Glashütte Forest Lands

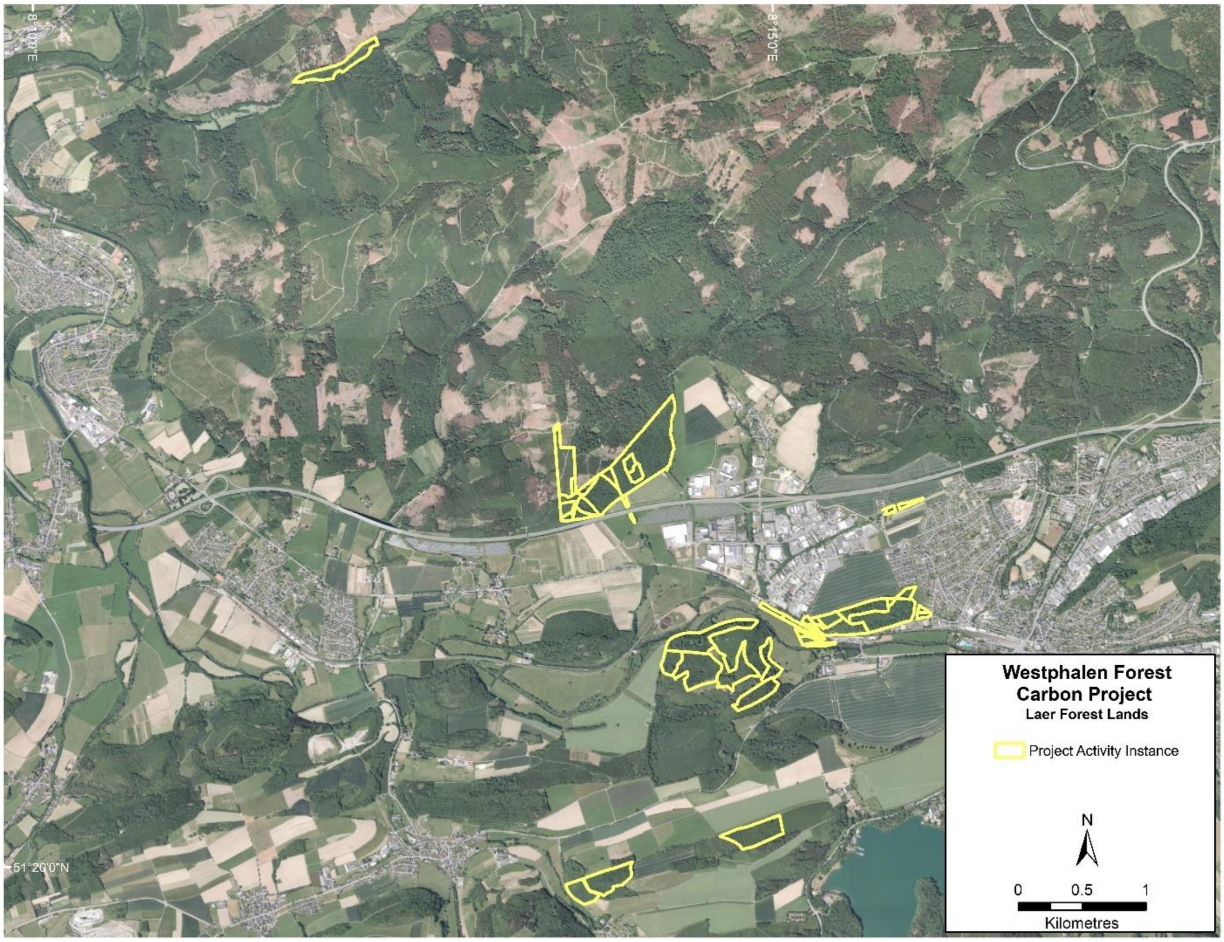

Figure 8: Detailed View of Laer Forest Lands

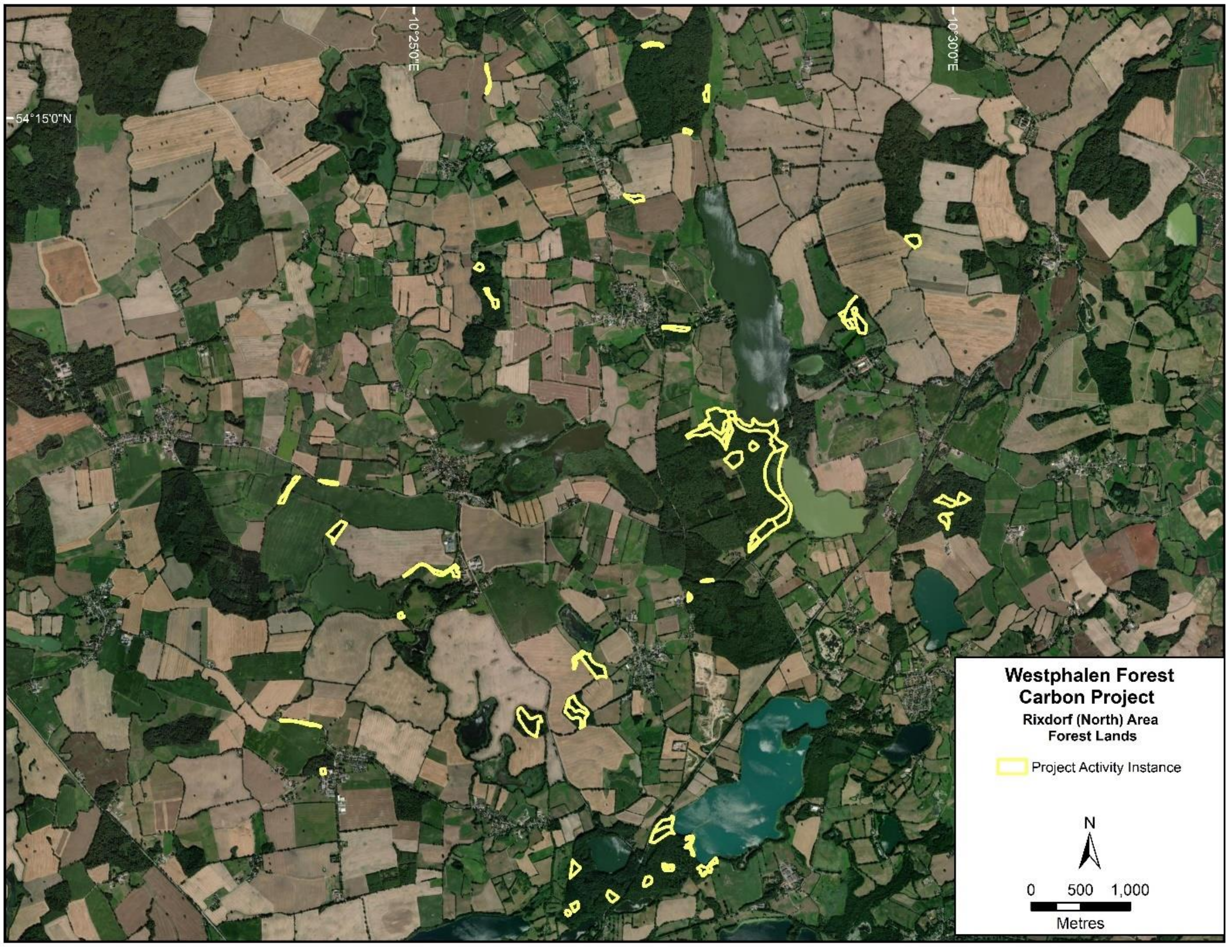

Figure 9: Detailed View of Rixdorf (North) Forest Lands

Figure 10: Detailed View of Rixdorf (Kiel) Forest Lands

Figure 11: Detailed View of Rixdorf (South) Forest Lands

3.4 Baseline Scenario

3.4.1 Step 1 – Identify Plausible Alternative Baseline Scenarios to the VCS Activity

The Westphalen Forest Carbon Project identified four potential baseline scenarios which were evaluated in the baseline selection process.

1. Historical Practice
   The VCS standard and VM0012 methodology require that the project proponent assess historical practice as a baseline scenario in Step 2a. The most recent harvesting plan created for the Westphalen forested areas was developed for a ten-year period from 2015 – 2025. Each area has a formulated objective yearly possibility of use volume associated with it. The total planned timber harvest for this period is approximately 54,173 m^3, of which 33,035 m^3 is sourced from commercial thinning, and 21,138 m^3 is for final fellings. The current harvest plan created for the project area is further described in Step 2a.
2. Common Practices
   The common practice and applicable scenario is to maximize the allowable timber harvest from the forest management plan. German forest management plans must be completed every 10 years, where the common practice is to harvest the annual volume objectives as detailed in the forest management plan. This common practice follows guidelines outlined in the German Civil Code and was corroborated by members of Westphalen (2021).
3. Land acquisition for conversion to real estate development
   An alternative baseline scenario would be to sell the lands within the project area to gain financial returns from the development and sale of these properties. Many portions of the project area are adjacent to residential areas, making them suitable for primary and secondary residences or industrial developments. This scenario emphasizes maximizing real estate opportunities within best use areas. These areas include shorelines along lakes and rivers, and properties adjacent to villages, towns, and cities.
4. Acquisition for conversion to conservation lands
   The last potential baseline scenario is the acquisition of the forest for conservation purposes. This scenario is representative of or comparable to, the project scenario without carbon crediting benefits. There is no credible market-based business model for this baseline scenario to provide financial returns for private investment capital as there are no material revenue returns from conservation activities like the project scenario. The inclusion of this scenario meets element 2.1.1 a), item ii) in the VCS Additionality Tool VT0001.

The italicized text below indicates VM0012 methodology or VCS requirements in the baseline scenario selection. Each prospective baseline scenario meets the following selection scenario eligibility criteria, except where noted and excluded:

1. *Including activities and areas where forests remain as forests* – this criterion eliminated the potential Baseline Scenario 3 "Acquisition for conversion to real estate development lands". For clarity, Scenarios 1,2 and 4 include only areas and activities where the forests remain forests.
2. *Comply with legal requirements for forest management and land use in the area* – all remaining baseline scenarios would meet the minimum practice requirements of either the German Federal Forest Act or the general rural residential policies, laws, and requirements.
3. *Demonstrate that the "projected baseline scenario environmental practices equal or exceed those commonly considered a minimum standard among landowners in the area" (Voluntary Carbon Standard, 2008a)* – all the prospective baseline scenarios comply with minimum environmental performance of landowners in the area.

3.4.2 Step 2 – Selection of a Single Plausible Baseline Scenario for the Project

Westphalen shall select a single plausible baseline scenario for the project using the following steps:

3.4.3 Step 2a – The Historical Baseline Scenario – based on historical operating practices on the property:

2a.1 Westphalen has at least 5 years of historical harvest level data history.

The most recent harvest plan for the project area was created by Westphalen in 2015 and is valid until 2025. The VM0012 methodology states that "projects may use a forward-looking forest management plan as the historical baseline data". The annual harvest volume is determined through historic growth and yield parameters available for each tree species present on particular growing site classes. The annual sustainable yield for thinning and conservation cutting is outlined in Westphalen's Forest Management Plan. The project area is 772 ha, with an annual harvest objective of approximately 5,510 m^3.

Table 17 Breakdown of Annual Harvest by Harvest Type (approx.)

Volume (m^3)	Type
2,150	Final Felling
3,360	Thinning

The timber harvest plan from the 2015-2025 period is designed to reflect market trends and forward-looking projections at the time of creation. It is anticipated that harvest volumes within the project area will be different when the 2025-2035 harvest plan is created. An updated harvest projection is not currently available, so the project will utilize the forward-looking harvest rate from the 2015-2025 harvest plan for the historical baseline scenario.

This baseline scenario is established on actual property harvest history and has been selected as the project proponent has at least 5 years historical harvest level data history. Step 2b and 2c will be omitted due to the acceptance of the historical baseline scenario in Step 2a.

3.4.4 Step 3 – Additionality Test

The Westphalen Forest Carbon Project is additional as per Section 3.5 in a manner consistent with the baseline selection method.

3.5 Additionality

The project uses the Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities:

The Westphalen Forest Carbon Project meets the eligibility requirements of this tool as:

1. The project activities are not in violation of any applicable law, or other regulatory framework.
2. The project employs a stepwise method to determine the most plausible baseline scenario, which is consistent with the application of this tool.

3.5.1 Step 1a – Identification of plausible baseline scenarios

1. Historical Practice (selected baseline scenario)
2. Common Practice
3. Acquisition for conversion to real estate development lands
4. Acquisition for conversion to conservation lands

3.5.2 Step 1b – Legal tests

The plausible baseline scenarios are governed by and in compliance with the German Constitution (Grundgesetz) and German Civil Code (Bürgerliches Gesetzbuch) and therefore meet the legal test requirements of privately managed forest lands in Germany. Project activities are not required or enforced by any German statute or regulatory framework.

3.5.3 Step 1c – Selection of Most Plausible Baseline Scenario

See Section 3.4 for a description of the baseline selection process.

The outcome of the selection process is to select the “Historical Practice” using the forward-looking ten-year forest management plans.

3.5.4 3.5.4 Step 2 – Investment Analysis

Sub-step 2a&b: Determine appropriate analysis method

As a Logged to Protected Forest conservation project, the project scenario of the Westphalen Forest Carbon Project will not generate material financial or economic benefits other than VCS related income. However, the project scenario includes low levels of calamity timber harvesting as part of conservation management and forest health maintenance. This timber harvesting will generate some revenue from timber sales.

The Net Present Value (NPV) investment comparison analysis has been selected as the analysis method for additionality. The NPV of the project scenario is compared to the NPV of the selected baseline scenario. The NPV method works well when comparing projects with varying cash flows over time and is a commonly used method for analyzing forestry investments.

Sub-step 2c – Calculation and comparison of financial indicators

A 30-year period was used to calculate the NPV of the baseline ("Historical Practice") scenario. The cash inflows and cash outflows used in the analysis were provided by management and are reflective of the actual average revenues and costs that have been incurred while conducting timber harvesting operations in the project area. Historically, operations have been profitable and so for the purposes of the NPV analysis a consistent profit margin is used for each year in the analysis.

A 30-year period was used to calculate the NPV of the carbon project scenario without the financial benefits from the VCS. There are cash inflows included in the project to account for the sale of timber resulting from low levels of stand maintenance (e.g., calamity [insect, windthrow] harvests). The sales price of this timber (on a €/m3 basis) is estimated to be 70% of the sales price that would be realized from regular timber sales. The cash outflows include property management costs, operational costs, and the costs associated with stand maintenance timber harvesting. The property management costs and operational costs are based on a €/ha basis. The property management costs relate to the annual management overhead costs and are assumed to be slightly reduced (~80%) of the baseline scenario amount. The operational costs include road maintenance, planting, etc. and are also assumed to be reduced (~50%) of the baseline scenario amount. The analysis assumes the costs associated with the stand maintenance harvesting are the same (on a €/m3 basis) to those of the baseline scenario.

The outcome of the NPV analysis is that the NPV for the baseline scenario is positive, whereas the NPV for the project scenario is negative. The difference is driven by the delayed onset of timber harvesting in the project scenario, as well as the lower harvest volumes once timber harvesting occurs. A positive profit margin (timber revenue less direct costs of harvesting) is assumed once timber harvesting commences in the carbon project scenario. However, the projected harvest volume is small and the profit from harvesting is unlikely sufficient to cover the property management and operational costs.

A discount rate of 4% was utilized in the analysis. This discount rate is slightly higher than the current German bank lending rate but is reflective of customary rates used for forestry in Germany. Irrespective of the discount rate used, the analysis indicates that NPV of the baseline scenario is always positive, and the NPV of the project scenario is always negative.

A detailed financial assessment is contained in the Excel document entitled 'Westphalen – Investment Analysis for Additionality Assessment'. This Excel document has been provided to the validation/verification body for review. This detailed financial assessment contains confidential information, and for this reason is not included in this section.

The results of the NPV comparison analysis illustrate that the proposed carbon project, without the financial benefits from the sale of VCU's, is a financially unattractive alternative when compared to standard historical practice.

Sub-step 2d – Sensitivity analysis

A sensitivity analysis was performed by reducing the amount of the fixed costs of the carbon project scenario.

The following costs were altered in the carbon project scenario for the sensitivity analysis:

- Property Management Costs These costs were reduced by 50% (in comparison to baseline scenario) for the remainder of the project
- Operational Costs These costs were reduced to 25% (of those in the baseline scenario) for the remainder of the project

Despite these cost assumption changes, the NPV of the carbon project scenario remained negative.

The sensitivity analysis is included in the Excel document 'Westphalen – Investment Analysis for Additionality Assessment. This Excel document has been provided to the validation/verification body for review.

For all reasonable variations in the cost assumptions for the carbon project scenario, it is concluded that the proposed VCS AFOLU project without the financial benefits from the VCS is unlikely to be financially attractive.

3.5.5 Step 3: Barrier Analysis (Supporting Information Only)

Additional barriers existing with those described in the Investment Analysis are described below.

3.5.5.1 Step 3a – Identify barriers that would prevent the implementation of the type of proposed project activity

There are barriers for private entities that undertake AFOLU activities:

Similar conservation activities have only been implemented in conservation areas with grants or funding from other compensation agencies or private individuals. The national program on Establishing and Securing Conservational Important Components of Nature and Landscapes of National Importance (Errichtung und Sicherung schutzwürdiger Teile von Natur und Landschaft mit gesamtstaatlich repräsentativer Bedeutung) is responsible for the establishment of conservation areas. Funding for conservation areas is provided by the federal and state governments, and registered associations. Lands are purchased and entered into long-term leases which pay compensation to cover costs of management. Existing conservation sites in Germany are limited in size, with 60% of them being smaller than 50 ha. The largest terrestrial conservation area is 28 ha. Many conservation areas continue to support industrial land use, limiting their effectiveness.

The Westphalen Forest Carbon Project is significantly unique in that it is large scale (772 ha), and no similar project activities are registered in Germany under the Verified Carbon Standard, The Gold Standard, or the Clean Development Mechanism.

3.5.5.2 Step 3b – Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity)

The scenarios related to historical practice and common practice are not affected by funding barriers associated with landscape conservation. The historical and common practice scenarios generate income from timber harvest. The real estate development scenario would receive financial benefits from both the sale of the property and standing timber on the property. The project scenario is the only scenario which is not financially beneficial from either property or timber sales. Therefore, the project scenario is unlikely to produce economic benefits or be financially attractive without the sale of carbon credits from the VCS AFOLU project.

3.5.6 Step 4: Common Practice Analysis

The Westphalen Forest Carbon Project is the first Improved Forest Management – Logged to Protected project to be implemented in Germany. The MoorFutures carbon project is the only other existing voluntary carbon crediting project in Germany. MoorFutures is a regionally applicable standard designed to generate carbon credits from the rewetting of bogs. This standard does not offer similar contributions to upland or forested areas, making it distinctly different from the Westphalen Forest Carbon Project scenario. Forest conservation projects are the most comparable to the project scenario, but do not offer the same extent of protection, or protection area, and are limited to government funding available (as noted above).

There are no other common practices which operate at a similar scale and achieve similar levels of carbon sequestration. Based on the application of the VCS tool (VT0001), the Westphalen Forest Carbon Project is additional based on Investment Analysis.

3.6 Methodology Deviations

A methodology deviation has been applied to the calculations for Market Leakage.

Refer to section 5.3.2 Market Leakage, for the updated procedure regarding the calculation of a market leakage factor.

This alternative calculation method utilizing MARketz Tool is intended to achieve a higher level of accuracy as it relates to project details (scope and scale) for market leakage quantification compared to the options within the VM0012 methodology and meets the suitability criteria as set out in section 3.19 of the VCS-Standard-v4.4.

No other deviations were required in the implementation of the VM0012 methodology.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The Westphalen Forest Carbon Project is seeking initial validation and verification from January 1, 2018, to December 31, 2021. Project activities during this period include ongoing low levels of management activities for forest maintenance, ecological enhancement, and/or risk mitigations. No events occurred during this monitoring period that have any impact on the GHG emission reductions or removals, as the ex-ante stocks are also the ex-post carbon stocks, due to the project start date commencing prior to validation.

Description of leakage monitoring and management can be found in Section 7.4. Non-permanence risk factors will be assessed at each monitoring period. The VCS non-permanence risk tool will be fully evaluated prior to each project verification.

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

5.1.1 Validating Inventory Requirements

The Westphalen Forest Carbon Project meets the Valid Starting Inventory Requirements from the methodology (methodology criteria in italics):

1. *Pertaining directly to the entire project area,* the Westphalen forest inventory data (2021) covers the entire project area and meets this criteria,
2. *Created, updated, or validated <10 years ago; and,*
3. *Documentation is available describing the methods used to create, update, or otherwise validate the starting inventory, including statistical analysis, field data, and/or other evidence.*

Westphalen's inventory methods and related inventory updates are documented in 10-year Forest Management Plans and silvicultural tending (sanitation cuts, thinning) activity documents, which therefore meets the criteria. Approved forest inventories dated 2005 and 2015 have been provided for validation/verification purposes.

5.1.2 Baseline Scenario Area Stratification

STEP 1 - Stratify to create homogeneous units.

Westphalen's forest inventory is documented in yield and inventory volume tables as well as a Geographic Information System (GIS) spatial dataset. The Westphalen forest inventory consists of multi storied structurally diverse stands and forest cover units are based on the leading species, productivity class, and other stand attributes including operability etc. The Carbon modeling is specific to the forest lands intended for regulated harvesting.

For modelling purposes, inventory polygons were further refined into Analysis Units (AUs) based on stand canopy structure (structure levels from 1-5, categorized as Main Stand, Regrowth, Understory, Overstory, and Post-Cut Remnant), yield class productivity (grouped from 1-5, 1 being best growth, 5 being lowest growth), and by leading species (Beech, Oak, and Spruce). Analysis units are described in the table below. Analysis units grouped by leading species in the main stand and by yield class in groupings.

Table 18: Description of Forest Analysis Units Defined in the Project Area

AU #	Gross Area (Ha)	Stratum Name
BZ1	185	Beech (0-1.4)
BZ2	254	Beech (1.5-2.4)
BZ3	197	Beech (2.5+)
OZ1	18	Oak (0-1.4)
OZ2	68	Oak (1.5-2.4)
OZ3	22	Oak (2.5+)
SZ1	25	Spruce (0-1.4)
SZ2	3	Spruce (1.5+)

Note: Spruce are not left below an elevation of 500m due to bark beetle infestations.

STEP 2 – Identify areas eligible for specific management activities.

The Westphalen Carbon Project area is subject to the Federal Governments forest policy frameworks as well as the implementation of federal state forest policies. The overall forest management objective is to employ close to nature forest management practices throughout Germany (see sec 1.14). To ensure baseline eligibility, the anticipated area should contribute to future diverse mixed stands, implement sustainable timber volume rates of cut in a harvest plan, and meet the following requirements:

1. Defined as forested areas (vs non-forested areas)
2. Considered merchantable and economically feasible to harvest.
3. Not within a legally restricted or protected area

The areas contributing to the baseline projection scenario is consistent with the common forest practices in Germany.

5.1.3 Model Selection and Use

The Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) is an inventory-based, yield-curve-driven model that simulates the stand- and landscape-level C dynamics of above- and belowground biomass, dead organic matter (DOM; litter and dead wood) and mineral soil (Kurz et al., 2009). The CBM-CFS3 is a stand- and landscape-level modeling framework that can be used to simulate the dynamics of all forest carbon stocks required under the United Nations Framework Convention on Climate Change. It is compliant with the carbon estimation methods outlined in the guidelines of the Intergovernmental Panel on Climate Change. The model uses much of the same information that is required for forest management planning activities (e.g., forest inventory, growth and yield curves, natural and human-induced disturbance information, forest management schedule, and land-use). The Archive Index Database (AIDB) is the Microsoft Access database behind the CBM-CFS3 that stores default ecological information and parameters pertaining to the forest ecosystems of a country, among other functions.

The (CBM-CFS3) has been adapted, tested, and applied to forests around the world over the last 7 years in support of policy making and scientific research.

The appropriateness of the selected model was determined via the methodology requirements listed in VM0012-Improved Forest Management Projects in Temperate and Boreal Forests LtPF v1.2, Section 8.1.1 Model Selection and Use:

1. Well Established:

- CBM-CFS3 was developed for carbon modelling purposes in 2001 by the Carbon Accounting Team of the Canadian Forest Service.

2. Generates values on an annual basis, or at intervals not exceeding 10 years:

- CBM-CFS3 can generate values in annual time-steps.

3. Include a reasonable representation of mortality from stand-self thinning and natural disturbance agents that are regionally appropriate.

- From the CB3-CFS3 User Guide: "The CBM-CFS3 allows users to explore a range of situations, including the effects of different levels of natural disturbances and management actions, and changes to growth and yield on forest ecosystem carbon stocks."

4. Output units expressed in carbon units (tC/ha) or as biomass (t/ha) and are calculated for each of the required carbon pools.

- Output units of tC/ha are generated from CBM-CFS3 (refer to CMB outputs).

5. Well Documented and expert reviewed:

- Google Search results in ~39,000 articles referencing "Carbon Budget Model Canadian Forest Sector" with the most recent publication occurring in January of 2022.

6. Parameterized, calibrated, and tested for the specific conditions in the project.

- Spatial Units and Boundaries within CBM-CFS3 model for Westphalen are as follows:
  - Administrative Boundary: ID 2 - Northrein_Westfalen-Germany
  - Ecological Boundary: CLU45 (Northrein_Westfalen)
  - Spatial Unit Group: SPU 3
- Recently National Forest Inventories (NFI) input data for 26 European Union (EU) countries was used to estimate the EU forest Carbon dynamics from 2000 to 2012, and updated in 2017, including the effects of natural disturbances and land-use change (Pilli et al., 2018). The overall purpose of this exercise was to increase the transparency of how the EU Archive Index Database (EU-AIDB) was parameterized while supporting both the policy making and research communities interested in applying the CBM-CFS3 with ecological parameters specific to the EU context. Currently the EU-AIDB incorporates 1034 spatial units representing the intersection of 204 European administrative regions, 35 ecological climatic units, and 192 main tree species parameters.

5.1.4 Preparation and Stand-level Carbon Curves in CBM EU

The CBM model was used to create a series of stand attribute curves for each analysis unit to predict/ simulate forest development, merchantable timber volume, and carbon storage and dynamics by carbon pool over time.

Growth and yield curves were developed for the purposes of carbon modelling. Data from Westphalen's forest stand inventory, stocking rates, and yield class classifications were used to set a representative yield curve for all forest polygons within Analysis Units (AUs).

The objective was to calibrate the CBM forest type for each Analysis Unit to generally match the dominant species (mix) found in the carbon monitoring plots which are then being represented by the simplified AU groupings with forest types based on species composition, site productivity and disturbance regime/ harvest history.

The AIDB spatial units (European SPU 3) were used for all analysis unit.

The CBM 'MAKELIST' is a preprocessing program that is used to format the inventory information for input into the CBM-CFS3 and to initialize the DOM carbon pools. These pools include carbon from aboveground and belowground dead tree biomass (e.g., coarse woody debris; litter, fibric, and humic layers; and mineral soil). MAKELIST uses the same algorithms and parameters as the CBM-CFS3 and simulates each stand record through several natural disturbance cycles (grow, burn, grow, burn, etc.) until the slow DOM carbon pool at the end of two successive rotations meets a user-defined criterion (for which the default tolerance is 0.1%). By default, the MAKELIST assumes that the historical natural disturbance regime is stand-replacing fire, and it therefore grows stands for 300 years for the particular disturbance period for the ecoregion.

5.1.5 Biomass Carbon Modeling

Total biomass flows for each analysis unit were calculated using equations embedded in the CBM-CFS3 and output by representative carbon curves and tracked by carbon pool (see Table 19 below – extracted from 2019 CBM-CFS3 users manual). The model simulates detailed forest growth and development over time and links this forest development to detailed biomass accumulation and decay functions to track carbon biomass by pool through time. The CBM converts the merchantable volume per ha reported by the growth curves (i.e., yield tables) to tonnes of Carbon (tC) through species-specific allometric equations (used as Biomass Expansion and Conversion Factors, without any additional value of wood density). All model outputs are in tonnes of Carbon (tC). Effectively CBM modelling manages the carbon pools addressed in VM0012 equations 1 through to 17b.

Table 19: CBM Carbon Pool allocation as detailed within Kurz et al., 2009 (Table 2)

Table 2 – Correspondence between pools in the Carbon Budget Model of the Canadian Forest Sector 3—version 1.1 (CBM-CFS3) and recommended pools by the Intergovernmental Panel on Climate Change Good Practice Guidance (GPG) (IPCC, 2003). SW = softwood, HW = hardwood, DOM = dead organic matter.

CBM-CFS3 pool	Description	GPG pool
Merchantable + bark (SW or HW)	Live stemwood of merchantable size[a] plus bark	Aboveground biomass
Other wood + bark (SW or HW)	Live branches, stumps and small trees including bark	Aboveground biomass
Foliage (SW or HW)	Live foliage	Aboveground biomass
Fine roots (SW or HW)	Live roots, approximately <5 mm diameter	Belowground biomass
Coarse roots (SW or HW)	Live roots, approximately ≥5 mm diameter	Belowground biomass
Snag stems DOM (SW or HW)	Dead standing stemwood of merchantable size including bark	Dead wood
Snag branches DOM (SW or HW)	Dead branches, stumps and small trees including bark	Dead wood
Medium DOM	Coarse woody debris on the ground	Dead wood
Aboveground fast DOM	Fine and small woody debris plus dead coarse roots in the forest floor, approximately ≥5 and <75 mm diameter	Litter
Aboveground very fast DOM	The L horizon[b] comprised of foliar litter plus dead fine roots, approximately <5 mm diameter	Litter
Aboveground slow DOM	F, H and O horizons[b]	Litter
Belowground fast DOM	Dead coarse roots in the mineral soil, approximately ≥5 diameter	Dead wood
Belowground very fast DOM	Dead fine roots in the mineral soil, approximately <5 mm diameter	Soil organic matter
Belowground slow DOM	Humified organic matter in the mineral soil	Soil organic matter

[a] Definition of merchantable size dimensions are model parameters, see Table 3.
[b] Soil Classification Working Group (1998).

In regard to model outputs the Stock Change resultant 'Delta Total Ecosystem' (ΔtC yr-1) represents Total change in Ecosystem carbon stocks (all pools) as required in Equation 1. The Stock Changes category of output variables contains information about changes in carbon stocks, reported in tonnes of carbon for each year, for the area selected by the user. A positive value (+) for annual change in carbon stock indicates a net gain in carbon stocks, a negative value (-) indicates a net loss, and a zero value indicates neither a gain nor a loss. For analyses of Total Delta Ecosystem, annual values greater than zero indicate that the ecosystem is functioning as a carbon sink, annual values below zero indicate that it is functioning as a carbon source, and an annual value of exactly zero indicates that the ecosystem is carbon-neutral (i.e., neither a source nor a sink).

5.1.6 Calculating Baseline Scenario Live Biomass Gain

For the Historic Baseline Scenario (as described in Section 3.4), a set of historic baseline activities (disturbances) was based on harvest details reported within existing FMPs. The annual harvest volume has been determined by forward looking harvest volumes within the same FMPs. All baseline management activities are assumed to occur/ begin at year 1 (2018).

Live biomass gain ($\Delta C_{BSL,G,t}$, Eqn 4, 5a-b) is calculated by CBM-CFS3 based on the project area and stratifications into analysis units. Regionally specific forest dynamics (Germany), and the related carbon curves discussed above, are tracked, and reported by carbon pool (e.g. Aboveground Live, Belowground Live), and reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009).

$\Delta C_{BSL,G,t} = \Sigma(A_{BSL,i} \bullet G_{BSL,i,t}) \bullet CF$, where; (4)

$A_{BSL,i}$, = area (ha) of forest land in polygon, i – Values generated based on Project Proponent FMPs.

$G_{BSL,i,t}$ = annual increment rate in tree biomass (t d.m. ha^{-1} yr^{-1}), in polygon, i, - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model)

CF = carbon fraction of dry matter t C t^{-1} d.m. - IPCC default value = 0.5

$G_{BSL,i,t} = G_{BSL,AG,i,t} + G_{BSL,BG,i,t}$, where; (5a)

$G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above and belowground biomass increment rates (t d.m. ha^{-1} yr^{-1}) - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model)

$G_{BSL,BG,i,t} = G_{BSL,AG,i,t} \bullet R_i$, where; (5b)

R_i = Root to shoot ratio - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model)

Equations embedded within the CBM-CFS3 model cannot be altered by the user.

5.1.7 Calculating Baseline Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{BSL,L,t}$, Eqn 6, 7, 8, 9) is calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dynamics, including natural tree mortality, harvesting scenario felling/ removals, blowdown, and any other biomass loss. Generally, mortality related live biomass is shifted into dead biomass pools by CBM-CFS3 (Aboveground Standing Dead (snags), Aboveground Downed and Dead Wood (DOM), Belowground DOM), which are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009).

$\Delta C_{BSL,L,t} = \Sigma(LBL_{BSL,NATURALi,t} + LBL_{BSL,FELLINGS,i,t} + LBL_{BSL,OTHER,i,t}) \bullet CF$, where; (6)

$LBL_{BSL,NATURALi,t}$ = annual loss of live tree biomass due to natural mortality in polygon, i; t d.m. yr^{-1}

$LBL_{BSL,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, i; t d.m. yr^{-1}

$LBL_{BSL,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, i; t d.m. yr^{-1}

CF = carbon fraction of dry matter; t C t^{-1} d.m. (IPCC default value = 0.5).

$LBL_{BSL,NATURALi,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,NATURAL,i,t}$, where; **(7)**

$A_{BSL,i}$ = area (ha) of forest land in polygon, i – values generated based on Project Proponent FMP data.

$LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, i, for year, t – values generated based on regionally specific forest dynamics within CBM-CFS3.

$LB_{BSL,I,t}$ is calculated for year, t, beginning with biomass estimates in year t=1 (the project start year) and with annual biomass increments ($G_{BSL,I,t}$) added as per calculations in equation 5a.

$f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon , i (unitless; $0 < f_{BSL,NATURALi} < 1$), year, t. – based on regionally specific forest dynamics (embedded within the CBM-CFS3 model), where;

$LBL_{FELLINGS,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,HARVEST,i,t}$, where; **(8)**

$A_{BSL,i}$ = area (ha) of forest land in polygon, i – values generated based on Project Proponent FMP data

LBBSL,i,t = average live tree biomass (t d.m. ha-1) in polygon, i, for year, t (see equation 7 for its calculation).

fBSL,HARVEST,i,t = the proportion of biomass removed by harvesting from polygon, i, (unitless; 0 < fBSL,HARVESTIi < 1), in year, t. Data for this variable is obtained through Project Proponent FMP data and historic harvest records.

Incidental loss (LBLBSL,OTHER,i,t; t d.m. yr-1) is the additional live tree biomass removed for road and landing construction in the polygon, i, and is calculated as a proportion of biomass removed by harvesting:

$LBL_{BSL,OTHER,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,DAMAGE,i,t}$, where; **(9)**

$A_{BSL,i}$ = area (ha) of forest land in polygon, i;

$LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, i, for year, t

$f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, i, year, t (unitless; $0 < f_{BSL,DAMAGE,i,t} < 1$). Values for this variable are based on regionally specific forest dynamics embedded within CBM-CFS3.

5.1.8 Calculating Baseline Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{BSLDOM,t}$, Eqn 10, 11a-b, 12, 13, 14a-b, 15, 16, 17a-d) are calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model track all stand dead wood dynamics, including standing dead, downed dead, and below ground dead organic matter. CBM-CFS3 uses the regionally specific variant data and related parameters to model and track dead organic matter between carbon pools (Aboveground Dead (i.e. Stem Snags), Belowground Dead, Aboveground Slow DOM (VM0012 calls this Lying Dead Wood)), and temperate related decay within each pool.

Additionally, CBM-CFS3 tracks dead organic matter dynamics related to harvesting (slash) or other events when applied. The project uses the default decay factors and dead matter dynamics that are set within the CBM-CFS3 model and specific to the variant dataset. The results of dead organic matter dynamics are reported in Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009). Generally, carbon stocks are transitioned between dead biomass pools, and emitted as they decay.

Equations were applied as follows:

$\Delta C_{BSL,DOM,t} = \Delta C_{BSL,LDW,t} + \Delta C_{BSL,SNAG,t} + \Delta C_{BSL,DBG,t}$, where; (10)

$\Delta C_{BSL,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr^{-1}

$\Delta C_{BSL,SNAG,t}$ = change in snag carbon stock in year, t; t C yr^{-1}

$\Delta C_{BSL,DBG,t}$ = change in dead belowground biomass carbon stock in year, t; t C yr^{-1}

$\Delta C_{BSL,LDW,t} = \Sigma(LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t}) \bullet CF$ (11a)

$LDW_{BSL,i,t+1} = LDW_{BSL,i,t} + (LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t})$ where; (11b)

$LDW_{BSL,,i,t}$ = The total mass of lying dead wood accumulated in polygon i , at time, t (t d.m.).

$LDW_{BSL,IN,i,t}$ = annual increase in LDW biomass for polygon i, year, t (t d.m yr^{-1}).

$LDW_{BSL,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon i, year, t, (t d.m yr^{-1})

$LDW_{BSL,IN,i,t}$ and $LDW_{BSL,OUT,i,t}$ are summed across polygons.

CF = carbon fraction of dry matter - *(IPCC default value = 0.5)*

$LDW_{BSL,IN,i,t} = (LBL_{BSL,NATURALi,t} - LBL_{BSL,NATURALi,t} \bullet R_i) \bullet f_{BSL,BLOWDOWN,i,t} + ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet f_{BSL,BRANCH,i,t} + ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri)) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet f_{BSL,BUCKINGLOSS,i,t} + SNAG_{BSL,,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t}$, where; (12)

LBLBSL,NATURALi,t, LBLBSL,FELLINGS,i,t, and LBLBSL,OTHER,i,t are as calculated in equations 7, 8, and 9, respectively.

Ri is the root:shoot ratio in polygon, i (see equation 5b). fBSL,BLOWDOWN,i,t = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t (unitless; 0 < fBSL,BLOWDOWN,i,t < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3.

fBSL,BRANCH,i,t = the annual proportion of aboveground tree biomass comprised of branches > 5 cm diameter in polygon, i (unitless; 0 < fBSL,BRANCH,i,t < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3.

fBSL,BUCKINGLOSS,i,t = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i (unitless; 0 < fBSL,BUCKINGLOSS,i,t < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3

SNAGBSL,,i,t = the total mass of the snag pool in polygon, i, year, t (see equation 14b).

fBSL,SNAGFALLDOWN,i,t = the annual proportion of snag biomass in polygon, i, year, t, that falls over and thus is transferred to the LDW pool (unitless; 0 < fSNAGFALLDOWN,i,t < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3

$LDW_{BSL,OUT,i,t} = LDW_{BSL,,i,t} \bullet f_{BSL,lwDECAY,i,t}$, where; **(13)**

$LDW_{BSL,,i,t}$ = the total amount of lying deadwood mass in polygon i, year, t (see equation 11b).

$f_{BSL,lwDECAY,i,t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon i, year, t (unitless; ; 0 < fBSL,lwDECAY,i,t < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3

$\Delta C_{BSL,SNAG,t} = \Sigma(SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t}) \bullet CF$ **(14a)**

$SNAG_{BSL,i,t+1} = SNAG_{BSL,i,t} + (SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t})$, where; **(14b)**

$SNAG_{BSL,i,t}$ = The total mass of snags accumulated in polygon i, at time t (t d.m.).

$SNAG_{BSL,IN,i,t}$ = annual gain in snag biomass for polygon i, year, t (t d.m yr^{-1}).

$SNAG_{BSL,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m yr^{-1})

CF = carbon fraction of dry matter *(IPCC default value = 0.5)*

$SNAG_{BSL,IN,i,t} = (LBL_{BSL,NATURALi,t} - LBL_{BSL,NATURALi,t} \bullet R_i) \bullet (1 - f_{BSL,BLOWDOWN,i,t})$, where; **(15)**

$LBL_{BSL,NATURALi,t}$ is as calculated in equation 7

1 - $f_{BSL,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, i, year, t, but remains as standing dead organic matter (i.e., snags) (unitless; 0 < $f_{BSL,BLOWDOWN,i,t}$ < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3.

$\Delta C_{BSL,DBG,t} = \Sigma(DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \bullet CF$ **(17a)**

$DBG_{BSL,i,t+1} = DBG_{BSL,i,t} + (DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t})$, where; **(17b)**

$DGB_{BSL,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon i, at time, t (t d.m.).

$DBG_{BSL,IN,i,t}$ = annual gain in dead belowground biomass for polygon i, year, t (t d.m yr^{-1}). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities.

$DBG_{BSL,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m yr^{-1})

CF = carbon fraction of dry matter (IPCC default value = 0.5)

$DBG_{BSL,IN,i,t} = [(A_{BSL,i} \bullet LB_{BSL,i,t} \bullet R_i) \bullet (f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t})]$, where; **(17c)**

$A_{BSL,i}$ = area (ha) of forest land in polygon, i; - values generated based on Project Proponent FMP data.

$LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, i, for year, t. $LB_{BSL,i,t}$ is calculated for year, t, beginning with biomass estimates in year t=1 (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5 a, b. This value is then multiplied by $A_{BSL,i,}$ the area (ha) of forest land in polygon, i.

R_i is the root:shoot ratio in polygon, i (see equation 5b).

$f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; 0 < fNATURALi < 1), year, t (see equation 7),

$f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; 0 < fHARVESTIi < 1), year, t (see equation 8),

$f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed or road and landing construction in polygon, i (unitless; 0 < fDAMAGE,i,t < 1), year, t (see equation 9)

$DBG_{BSL,OUT,i,t} = DBG_{BSL,i,t} \bullet f_{BSL,dgbDECAY,i,t}$, where; **(17d)**

$DBG_{BSL,i,t}$ = the total quantity of dead belowground in polygon i, year, t (see equation 17b).

$f_{BSL,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon i, year, t (unitless; 0 < $f_{BSL,lwDECAY,i,t}$ < 1) – values generated based on regionally specific forest dynamics within CBM-CFS3

5.1.9 Harvested Wood Product Modeling

Step 1 utilizes CBM output reports that forecast species, product groups (e.g., Fuel Wood, Sawlogs) and related harvest volumes (m^3) for each planning period. These are then converted to Merchantable Carbon/ Wood Products pool using species specific wood densities in Tonnes of Carbon (tC) and satisfies the requirements of Step 1 of the methodology.

The following product groups from harvest groups and species were assigned to the following product type (k) categories, fuelwood and saw logs (softwood, hardwood).

1. Sawlogs
2. Fuelwood
3. Pulpwood

For the purposes of Step 2 (Carbon contained in harvested timber after milling, ($C_{BSL,MILL,h}$; tC, Equation 21) Forest Product Conversion Factors for the UNECE Region published by the United Nations Economic Commission for Europe (UNECE/FAO. 2010) ($f_{RND,k}$, $r_{RND,k}$) was used to determine the total carbon in harvested timber that will enter the wood products pool by product type accounting for mill efficiencies and estimated product disposition percentages. The gross quantity of carbon contained in harvested timber for each of the four product types (k) described in Step 1 must be decremented (process of decreasing or becoming gradually less) to account for losses during processing. This loss is calculated within the excel spread sheet specifically tab ‘Step 2 (Mill)’.

VM0012 requires calculation of 3 harvested wood pools:

1. Short-lived wood products (SLF), which are defined as wood products in use for <3 years; and assumed to be emitted immediately.
2. Medium-lived wood products (MLF), which are defined as wood products in use for 3-100 years; and assumed to be emitted on a 20-year straight line decay curve.
3. Long-lived wood products (LLF), which are wood products in use for 100+ years.

Note: products in landfill are assumed to be "in use" and treated as per these 3 HWP pools.

For the final step 3 (Carbon storage in medium-term and long-term wood products, $C_{BSL,STORHWP,t}$, Equation 23) the total carbon lost in short-lived products (SLF – $P_{BSL,SLF,k}$, Equation 22a) and stored in medium-term (MLF - $P_{BSL,MLF,k}$, Equation 22c) and long-term (LLF - $P_{BSL,LLF,k}$, Equation 22b) products used Smith, et al (2006) reference tables and factors to calculate the result is a fraction of the Wood Products pool being emitted or stored annually based on each 'In-Use' category based on product, decay and storage factors. These values are summed for every year (t) utilizing a cohort approach.

The annual change in carbon storage in harvested wood products (ΔCBSL,STORHWP,t; t C yr-1, Equation 19) is calculated from the annual results of Equation 23.

These HWP modelling calculations are applied equally to any timber harvesting in either the Baseline or Project Scenario as follows:

$$\Delta C_{BSL,STORHWP,t} = (C_{BSL,STORHWP,t2} - C_{BSL,STORHWP,t1}) / T \text{, where;} \quad (19)$$

$C_{BSL,STORHWP,t2}$ = carbon storage in harvested wood products at t=2; t C

$C_{BSL,STORHWP,t1}$ = carbon storage in harvested wood products at t=1; t C

T = number of years between monitoring t1 and t2

t : 1,2,3…t years elapsed since the project start date

$$C_{BSL,TIMBER,h} = \Sigma[(LBL_{BSL,FELLINGS,i,h} - LBL_{BSL,FELLINGS,i,h} \bullet R_i + LBL_{BSL,OTHER,i,h} - LBL_{BSL,OTHER,i,h} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,h}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,h})] \bullet CF \text{, where;} \quad (20)$$

$C_{BSL,TIMBER,h}$= carbon contained in timber harvested in period h (summed for all harvested polygons, i); t

$LBL_{BSL,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, i; t d.m. (equation 8)

$LBL_{BSL,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. (equation 9)

R_i is the root:shoot ratio in polygon, i (see equation 5b)

1 - $f_{BSL,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon i (unitless; 0 < $f_{BRANCH,i,t}$ < 1) (see equation 12)

1 - $f_{BSL,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, i (unitless; 0 < $f_{BUCKINGLOSS,i,t}$ < 1) (equation 12)

h = harvest period ; yr

$C_{BSL,MILL,h,k} = (C_{BSL,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k})$, where; **(21)**

$C_{BSL,MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type k; t C

$C_{BSL,TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type k; t C – values generated from CBM-CFS3 outputs (total Softwood Merch, Softwood "other", Hardwood Merch, Hardwood "other").

k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood); - *proportions determined by project proponent via FMP data and historic harvest records.*

$f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type k – not utilized as values for $C_{BSL,TIMBER,h,k} = C_{BSL,MILL,h,k}$ via CBM-CFS3 analysis

$r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type k. – not utilized as values for $C_{BSL,TIMBER,h,k} = C_{BSL,MILL,h,k}$ via CBM-CFS3 analysis

Values for forest product conversion factors for coniferous sawnwood:

- Sawdust: 7%
- Shavings: 8%
- Chips/slabs: 29%
- Chips: 6%

$P_{BSL,SLF,k} = 1\text{-}P_{3\text{-year}}$ **(22a)**

- P-SLF Values used:
  - Softwood Sawlog – 0.505
  - Hardwood Sawlog – 0.5
  - Softwood Pulp – 0.683
  - Hardwood Pulp – 0.504

$P_{BSL,LLF,k} = P_{100\text{-year}}$ **(22b)**

- P-LLF Values used:
  - Softwood Sawlog – 0.095
  - Hardwood Sawlog – 0.035
  - Softwood Pulp – 0.006
  - Hardwood Pulp – 0.103

$P_{BSL,MLF,k} = P_{3\text{-year}} - P_{100\text{-year}}$ **(22c)**

- P-MLF Values used:
  - Softwood Sawlog – 0.40
  - Hardwood Sawlog – 0.465

- Softwood Pulp – 0.311
- Hardwood Pulp – 0.393

$C_{BSL,STORHWP,t,} = \Sigma\, \Sigma\, ((\, C_{BSL,MILL,h,k} \bullet P_{LLF,k}) + [(C_{BSL,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20\text{-}h) / 20)])$ (23)

$C_{BSL,STORHWP,t,}$ = carbon stored in harvested wood products in year t summed for all product types k and then over all harvest periods h; t C

k = wood product type – *(softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood); proportions determined via FMP data*

h = year of harvest (the term (20-h) should not be allowed to drop below 0)

5.1.10 Fossil fuel emissions associated with logging, transport, and manufacture

Westphalen has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., thinning), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups).

Default values in VM0012 Table 4 (Carbon emission intensity factors for harvesting) have been used for Equations 24 – 27. All calculations in support of this are within the *Westphalen Final GHG Estimate* spreadsheet.

Existing FMPs that forecast species, product groups and related harvest volumes (m^3) for each planning period were used for the following calculations. Results are then converted to Merchantable Carbon pool using species specific wood densities along with a Carbon Fraction (CF = 0.5) providing Tonnes of Carbon (tC) harvested for each planning period. This is equivalent to $C_{BSL,TIMBER,h}$ as represented by Eq. 20 being the carbon contained in timber harvested in period h.

The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as:

$C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t}$ where: (24)

$C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr^{-1})

$C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr^{-1})

$C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr^{-1})

$C_{BSL,EMITHARVEST,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t)]} \bullet CF \bullet c_{HARVEST,}$ where; (25)

$c_{HARVEST}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting. All timber in the PAI is harvest via thinning and final felling and the 'clearcutting' default value for cHARVEST is used (*VM0012 Table 4)* all other terms are as defined in equation 20.

$C_{BSL,EMITTRANSPORT,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet \Sigma(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk})$,
where; **(26)**

$f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; 0 < $f_{BSL,TRANSPORTk}$ < 1).

$d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); these values were generated via proponent historic harvest levels as average distances from the forest fund property to the customer location – this estimate is conservative in nature. The average speed is travelled by logging trucks is 60 km/hr.

$c_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k - *VM0012 Table 4 default value for Truck (7.0 * 10^{-5-}) utilized.*

$C_{BSL,EMITMANUFACTURE,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet \Sigma(f_{BSL,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF$, where; **(27)**

$c_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k; - *VM0012 Table 4 default value for Sawnwood (0.04), chemical pulp (0.13) and veneer (0.06) were utilized.*

All other terms are as defined in equation 19.

5.2 Project Emissions

In regard to model outputs the Stock Change resultant 'Delta Total Ecosystem' (ΔtC yr^{-1}) represents Total change in Ecosystem carbon stocks as required in Equation 1: annual change in living tree biomass ($\Delta C_{BSL,LB,t}$) (Refer to Sections 5.1.6 & 5.1.7) and annual change in dead organic matter ($\Delta C_{BSL,DOM,t}$) (Refer to Section 5.1.8). CBM also provides the required output for the annual change in carbon stocks associated with harvested wood products ($\Delta C_{BSL,HWP,t}$) (Refer to Section 5.1.9).

The Stock Changes category of output variables contains information about changes in carbon stocks, reported in tonnes of carbon for each year, for the area selected by the user. A positive value (+) for annual change in carbon stock indicates a net gain in carbon stocks, a negative value (-) indicates a net loss, and a zero value indicates neither a gain nor a loss. For analyses of Total Delta Ecosystem, annual values greater than zero indicate that the ecosystem is functioning as a carbon sink, annual values below zero indicate that it is functioning as a carbon source, and an annual value of exactly zero indicates that the ecosystem is carbon-neutral (i.e., neither a source nor a sink). Refer to the *GHG Estimate calculation* spreadsheet provided.

Project activities affecting GHG emissions were carried out during the initial project period (2018 – 2021) however, no project scenario activities were projected on an *ex-ante* basis. Future years may include various project forest management activities that affect *ex-post* carbon stocks which will be monitored and reported on in future verifications (e.g., salvage due to significant fire or forest health loss). Project activities will be based on actual monitoring results (see Monitoring Section 6) and any resulting emissions netted against emission reductions.

The methods described are equivalent to the equations and processes outlined in VM0012.

5.2.1 Development of Project Scenarios and Assumptions

The project scenario is modeled as conservation, LtPF, with a focus on maintaining forest health if required. No other activities affecting carbon stocks are scheduled on an *ex-ante* basis, aside from normal forest growth and development as modeled by CBM-CFS3 EU AID (SPU 3).

5.2.2 Determination of Actual Onsite Carbon Stocks

Ex-ante Project Scenario carbon stocks are calculated in the same manner as the baseline emissions discussed in Section 5.1. Calculations are completed using the same forest inventory data, analysis units and polygons, and modeling tools under the Project Scenario activities.

5.2.3 Ex-Post Calculations of Carbon Stocks

Ex-post carbon stocks in the Project Scenario are determined at each verification following the steps outlined in VM0012. Each monitoring report will detail the data and calculations for *ex-post* onsite carbon stocks at the time of verification. However, as the project start date (2018) is prior to validation, the initial period (01-January-2018 to 31-December-2021) *ex-ante* carbon stocks are also the *ex-post* carbon stocks.

Project carbon stocks from 2022 forward are on an estimated *ex-ante* basis.

The *ex-post* carbon calculations are made for the Baseline and Project Scenarios as outlined in Section 7.2 and 7.3 respectively, with updates to carbon inventory, spatial data, project instances, and other data for each verification period.

For the 01-January-2018 to 31-December-2021 period, the carbon stocks are calculated from the latest set of inventory and spatial data, which inherently include *ex-post* monitoring for that period.

31 permanent carbon plots were established in 2022 (see Section 6.3.2), with representation across all analysis units to monitor inventory and model accuracy. Additional permanent sample plots may be installed to improve inventory accuracy, spatial coverage, and Analysis Unit representation as deemed necessary. The initial *ex-post* carbon stock spatial forest inventory and analysis is using the latest available ortho-imagery, LiDAR data, and other GIS datasets, in conjunction with site visits from Project Proponent staff to confirm the status of project activities and disturbances. The modeling related to these data has been applied across both the Project Scenario and Baseline Scenarios. The uncertainty calculations in the first verification period are up to date for the latest inventory plot data and modeling results.

In future verification periods, the project will calculate *ex-post* carbon stocks by addressing any spatial changes to the project area, then updating the forest inventory and carbon modeling results, including for any other monitoring results or updates.

Additional carbon plots may be installed to improve inventory accuracy, spatial coverage, and/or Analysis Unit representation. *Ex-post* carbon calculations will be undertaken using the latest imagery, LiDAR, and GIS datasets for the project area. Project activities and disturbances will be monitored by remote sensing or field visits and updated into the forest inventory prior to the following verification period. All modeling and inventory updates and calibrations will be applied equally across the Project and Baseline Scenarios. The uncertainty factor, leakage assessments, and non-permanence risk factors will be recalculated using the latest forest inventory, plot data, and project information.

5.3 Leakage

5.3.1 Activity Shifting Leakage

VM0012 does not provide specific equations nor methods for calculating net emissions related to activity shifting leakage. VCS requires that “IFM project developers must demonstrate that there is no leakage within their operations – i.e., on other lands they manage/ operate outside the bounds of the VCS carbon project”. The methodology requires monitoring and reporting on evidence demonstrating no activity shifting is occurring to demonstrate compliance with VCS.

STEP 1 - the locations and descriptions of all forestlands within the project over which the Project Proponent has ownership is available.

STEP 2 –demonstrate that there is no activity shifting leakage to areas that are outside the project instances and that have not materially changed as a result of the project activity (e.g., harvest rates have not been increased).

In addition to the 772-ha project activity instance, Westphalen owns and controls operations on 7,076-ha of forest lands comprised of a mosaic of freehold properties in the states of Schleswig-Holstein, Thuringia, North Rhine-Westphalia, and Lower Saxony. All forest related activities on the above lands are moderated by Westphalen under two FMPs (NRW and Rixdorf).

Project lands are managed under private forest land requirements, thus harvest levels can shift based on market demand, weather, human and capital resources, corporate strategic/tactical decisions, political/ regulatory changes, calamities etc. In order to determine if harvests occurring during the project lifetime would be considered activity shifting, a baseline (historic) harvest variance needed to be determined.

To determine a baseline variance, annual harvest objectives from the 2015 to 2025 forest management plans will be compared to actual cumulative harvest volumes of the same years. For the purposes of this analysis, it should be noted that yearly harvesting volume objectives from the forest management plans do not need to be adhered to on an annual cut basis. Volumes harvested at any time within the FMP timeframe must not exceed the predetermined 10-year quota (harvesting volumes may shift annually within a ten-year cutting period).

If harvest levels exceed the predetermined activity shifting threshold (FMP quota minus carbon project, conserved volume), then activity shifting would be determined as occurring. Note, any harvested volume due to insect, wildfire, or drought damage (termed calamity), is not considered contributory to the FMP harvest quotas as it is compulsory to sanitary harvest. Under such circumstances the German Federal Government issues special tax rates under the Income Tax Act 34b, *Tax Rates for Income From Extraordinary Wood Uses*7. This was enacted to address insect and wildfire salvage operations, such as the heavy Spruce Beetle damage that occurred in many states of Germany in the later half of 2017 to 20208. The ensuing harvest volumes are then adjusted accordingly for the next FMP 10-year period.

The figure below demonstrates yearly cumulative comparisons of forest management plan (FMP) harvest amounts to actual annual harvested volumes. Based on this assessment, it can then be determined at project implementation if activity shifting leakage is occurring as demonstrated by the chart below. Refer to Section 7.4 for Activity Shifting Leakage assessment for the verification period.

[7] See Bundesministerium der Justiz website for more details regarding tax act: § 34b EStG - individual standard (www-gesetze--im--internet-de.translate.goog)

8 See Germany Statistics Destatis website: 2022 All-time high of timber logged in 2021 - German Federal Statistical Office (destatis.de)

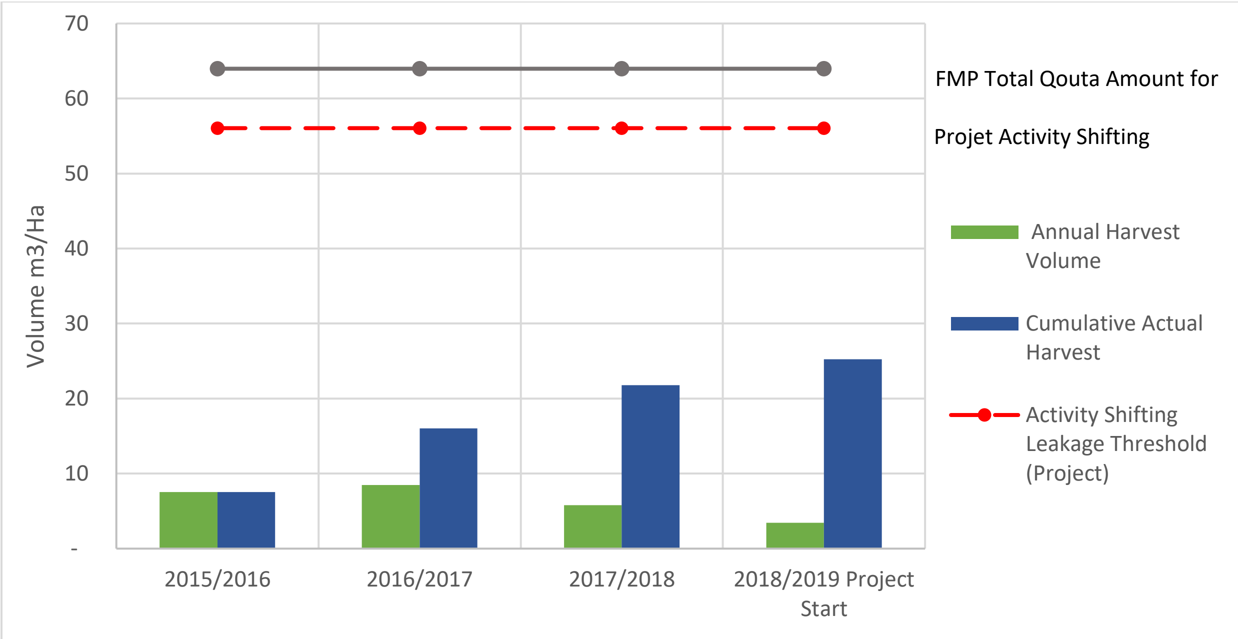

Figure 12: Westphalen's Planned and Actual Volume Harvest Comparisons at project initiation (all values in m³/ha).

5.3.2 Market Leakage

The VM0012 LtPF methodology provides the following definition (Section 8.3.2): market leakage risk occurs when a project significantly reduces the production of a commodity causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply.

For the calculation of Market Leakage a methodology deviation as noted in section 3.2 has been utilized. In this regard the MARketz tool has been populated for the Westphalen Project. Full details supporting the development and use of the MARketz tool in provided in the appendices. The intent is to ranks each assessment as a low, moderate or high risk of market leakage.

Below is a summary of results for each of the market assessments comprising the tool:

1. Market Determination: the market determination assessment and quantification of a Domestic Leakage Factor seeks to define the proportion of potential leakage that will occur in domestic markets versus international markets. Data is sourced from the BMEL-Statistik.de website specifically file 'SJT-8070300-0000.xlsx Supply balance for round wood'[9]. The international Leakage Factor applied is 15.3%.
2. Market Equilibrium: this assessment seeks to determine the effects the project will have on the production and consumption within the host country, while taking a comprehensive set of global economic factors into account. The Global Forest Products Model (GFPM, v2020[10]) developed by Buongiorno et al. is utilized. For the project run of the model 1000ha (770ha rounded up) was removed from the total timber harvesting landbase. The first year of disturbance to market equilibrium in the amount of total production or consumption was 2065. As this is greater than 40 years from the project start date the assessment results in a low risk of market leakage.
3. Barriers - A. Distribution Barrier – Cost of Transportation: the assessment is conducted to determine the potential spatial extent of market leakage effects as determined by the cost of transporting wood products. Where the cost of transportation increases by 15% or more this represents a market barrier. No barriers were identified at the local or regional level but was identified at the national level making the project a moderate risk of market leakage[11]. This is adequately reflected in historical market sales records prior to project implementation.
3. Barriers - B. Regulatory Barrier – Jurisdiction: this assessment is conducted to determine the potential legal extent of market leakage effects as determined by ownership type within the project country. Information regarding laws and regulations impacting cut control were sourced from the FSC CW Risk Assessment for Germany[12]. Data is sourced from the BMEL-Statistik.de website specifically file 'SJT-7010200-2012.xlsx Forest area by property type and forest

[9] https://www.bmel-statistik.de/forst-holz/tabellen-zu-forst-und-holzwirtschaft

[10] https://buongiorno.russell.wisc.edu/gfpm/

[11] Source: Dr. Johannes Gerst personal communication September 13, 2023

[12] https://connect.fsc.org/document-centre/documents/resource/201

category'[13]. Given the split between ownership with quota-based legislation and those without similar restrictions the project has a moderate risk of market leakage for this aspect.

4. Product Substitutability: the purpose of assessing product substitutability is to determine if a different product can be used in place of ones that would be generated in the baseline scenario. If there is high substitutability, there is a higher risk of market leakage due to the product being easily replaced with another product. Substitutability Factors are sourced from BC FCOP 2.0. currently under consultation, and notes the substitutability of wood products has a significant effect on the ultimate leakage estimate[14]. Given the high proportion of the project being made up of moderately substitutable products (i.e. European beech (*Fagus sylvatica L.*)) the project has a moderate risk of market leakage for this assessment.

5. Land/Carbon Impact - A. Percent of National Inventory: the assessment is conducted to determine the scale of the carbon project compared to the national inventory of the host country. The result of this assessment provides a scaled or proportional analysis of the implementation of the project scenario as it relates to national resources. Data is sourced from the BMEL-Statistik.de website specifically file 'SJT-7010400-2012.xlsx Forest area by property type and forest category' along with the most current national inventory[15]. Given the small size of the project in relation to the national inventory there is a low risk of market leakage.

5. Land/Carbon Impact - B. Biomass Ratio of Project (compared to national inventory): the assessment of the biomass ratio of the project compared to the national inventory (or leakage area) follows the biomass ratio assessment commonly used within several AFOLU methodologies. Data is sourced from the BMEL-Statistik.de website specifically file 'SJT-7010400-2012.xlsx Forest area by property type and forest category' along with the most current national inventory[16]. Given the variable biomass ratio of stand types in relation to the potential leakage area the project may be subject to a moderate risk of market leakage.

Market Leakage Determination

Market leakage risk occurs when a project significantly reduces the production of a commodity causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply. Within the MARketz tool a score of each assessment is gathered on the Market Score Card within the excel workbook and has been provided during validation and verification. The market score card calculates the overall weighted score of all the assessments, produces the resulting assessment score as a percentage, and the corresponding Market Leakage Factor.

In conclusion, the detailed analysis Westphalen Forest Carbon project conducted utilizing the MARKetz tool calculates a Market Leakage Factor (MLF_y) of 20%.

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[13] https://www.bmel-statistik.de/forst-holz/tabellen-zu-forst-und-holzwirtschaft

[14] https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/offset-projects/consultation

[15] https://www.bmel-statistik.de/fileadmin/daten/7010400-2012.xlsx and the https://www.thuenen.de/en/thuenen-topics/forests/the-german-national-forest-inventory

[16] https://www.bmel-statistik.de/fileadmin/daten/7010400-2012.xlsx and the https://www.thuenen.de/en/thuenen-topics/forests/the-german-national-forest-inventory

5.4 Estimated Net GHG Emission Reductions and Removals

Estimated net GHG emission reductions and removals are calculated based on estimated baseline and project emissions, calculated as described in Sections 5.1 (Baseline Emissions) and Section 5.2 (Project Emissions).

5.4.1 Calculation of Emissions Reductions

Gross carbon emissions reductions ($ER_{y,GROSS}$; t CO_2e yr^{-1}) created by the Westphalen Forest Carbon Project were calculated annually as the difference between the baseline and project scenario emission reductions/emissions:

$$ER_{y,GROSS} = (\Delta C_{BSL,t} - \Delta C_{PRJ,t}) \bullet 44/12 \qquad (57)$$

Where,

$\Delta C_{BSL,t}$ = total baseline scenario emissions calculated from equation 1 (t C yr^{-1}).

$\Delta C_{PRJ,t}$ = total project scenario emissions calculated from equation 29 (t C yr^{-1}).

44/12 = factor to convert C to CO_2e

The annual net GHG emissions reductions are calculated each year using Equation 58.

$$ER_y = ER_{y,GROSS} - LE_y \qquad (58)$$

where:

ER_y = the net GHG emissions reductions and/or removals in year y (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) (t CO_2e yr^{-1}).

$ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios (t CO_2e yr^{-1}).

LE_y = Leakage in year y (t CO_2e yr^{-1}), as calculated in equation 56b below.

$$LE_y = MLF_y \bullet ER_{yGROSS} \qquad (56b)$$

Ex-ante net GHG emissions are calculated below:

Table 20: Ex-ante net GHG Emissions

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
01-January-2018 - 31-December-2018	-4,058	-978	616	2,464

01-January-2019 - 31-December-2019	-4,255	-4,000	51	204
01-January-2020 - 31-December-2020	-4,555	-1,909	529	2,117
01-January-2021 - 31-December-2021	-4,770	5,363	2,027	8,106
01-January-2022 - 31-December-2022	-5,028	-12,322	(1,459)	-5,835
01-January-2023 - 31-December-2023	-5,395	2,758	1,631	6,523
01-January-2024 - 31-December-2024	-5,902	3,137	1,808	7,231
01-January-2025 - 31-December-2025	-6,003	3,395	1,879	7,518
01-January-2026 - 31-December-2026	-6,177	7,294	2,694	10,777
01-January-2027 - 31-December-2027	-5,815	2,307	1,624	6,497
01-January-2028 - 31-December-2028	-5,924	2,393	1,664	6,654
01-January-2029 - 31-December-2029	-5,760	2,465	1,645	6,580
01-January-2030 - 31-December-2030	-5,626	2,482	1,622	6,486
01-January-2031 - 31-December-2031	-5,595	2,527	1,624	6,497
01-January-2032 - 31-December-2032	-5,091	2,520	1,522	6,089
01-January-2033 - 31-December-2033	-5,766	2,546	1,662	6,650
01-January-2034 - 31-December-2034	-5,636	2,539	1,635	6,539
01-January-2035 - 31-December-2035	-5,651	2,541	1,638	6,554
01-January-2036 - 31-December-2036	-5,939	2,549	1,698	6,790
01-January-2037 - 31-December-2037	-4,140	2,526	1,333	5,333
01-January-2038 - 31-December-2038	-5,743	2,467	1,642	6,568
01-January-2039 - 31-December-2039	-5,342	2,449	1,558	6,232
01-January-2040 - 31-December-2040	-4,882	2,414	1,459	5,837
01-January-2041 - 31-December-2041	-5,101	2,373	1,495	5,979
01-January-2042 - 31-December-2042	-3,900	2,250	1,230	4,920
01-January-2043 - 31-December-2043	-5,337	2,258	1,519	6,075
01-January-2044 - 31-December-2044	-2,792	2,228	1,004	4,017
01-January-2045 - 31-December-2045	-5,962	2,206	1,633	6,534
01-January-2046 - 31-December-2046	-6,194	2,219	1,683	6,731
01-January-2047 - 31-December-2047	-5,962	2,189	1,630	6,520
Total	**-158,298**	**53,185**	**42,297**	**169,187**

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	Spatial Inventory data ($A_{BSL,i}$, $A_{PRJ,i}$),i
Data unit	Hectares (Ha)
Description	Respective areas of baseline and project polygon, i for all project instances
Source of data	GPS Coordinates, inventory records, spatial data using a Geographic Information System (GIS)
Value applied:	Each polygon has an area
Justification of choice of data or description of measurement methods and procedures applied	GIS spatial delineation of project areas and tabular forest inventory classes. An ESRI GIS software program is used to integrate data from various sources and its derivatives (areas, perimeters etc.)
Purpose of Data	Required for baseline and project calculations
Comments	Includes delineation of project areas and polygons

Data/Parameter	CF
Data unit	t C t-1 d.m
Description	Carbon fraction of dry matter
Source of data	IPCC 2006 default value
Value applied:	0.50
Justification of choice of data or description of measurement methods and procedures applied	Best available data
Purpose of Data	Required for baseline carbon and project calculations

Comments	Embedded in CBM CFS3 EU-AIDB SPU 3

Data / Parameter	BEF
Data unit	Unitless
Description	Biomass expansion factors (BEF) for conversion of productivity metrics to biomass,
Source of data	CBM-CFS3 default values.
Value applied:	CBM-CFS3 calculates the Biomass Expansion Factor as a function of jurisdiction, ecozone and tree species.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 data is widely reviewed and accepted.
Purpose of Data	
Comments	Calculation of baseline and project emissions.

Data / Parameter	R_i
Data unit	Unitless
Description	Root:to shoot ratio in polygon, i
Source of data	CBM-CFS3 default values.
Value applied:	CBM-CFS3 variants calculates belowground biomass as a function of tree species and tree size.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 data is widely reviewed and accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	Root allocation can vary by site productivity.

Data / Parameter	$f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 < f_{BSL,NATURALi}$, $f_{PRJ,NATURAL,i,t} < 1$)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3.
Value applied:	Default settings in CBM-CFS3.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for baseline and project calculations.
Comments	

Data / Parameter	$f_{BSL,DAMAGE,i,t}$, $f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{BSL,DAMAGEi,t}$ $f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of additional biomass removed by for road and landing construction in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	As described in the management plan for road development. Monitoring data on an *ex-post* basis in the project scenario.
Value applied:	Variable on an *ex-post* basis in the project scenario - digitized in the project scenario on an *ex-post* basis if visible in remote sensing or captured by standing stocking estimates. Captured within the clearing component of the baseline scenarios.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on expert opinion based on regional experience.
Purpose of Data	Required for calculation of baseline and project emissions.

Comments	

Data / Parameter	$f_{BSL,BLOWDOWN,i,t}$, $f_{PRJ,BLOWDOWN,i,t}$
Data unit	unitless ($0 < f_{BSL,BLOWDOWNi,t}$, $f_{PRJ,BLOWDOWN,i,t} < 1$)
Description	The proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Included within the natural mortality factors calculated in $f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$ by CBM-CFS3. Also captured by spatial monitoring if >4ha, which would be incorporated as a new polygon on an *ex-post* basis.
Value applied:	Zero for the baseline and project *ex-ante* calculations (part of the natural mortality modeling in CBM-CFS3).
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,BRANCH,i,t}$, $f_{PRJ,BRANCH,i,t}$
Data unit	unitless ($0 < f_{BSL,BRANCHi,t}$, $f_{PRJ,BRANCH,i,t} < 1$)
Description	The proportion of aboveground tree biomass comprised of branches > 2 in diameter in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Calculated within CBM-CFS3.
Value applied:	Variable, see source data.

Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,BUCKINGLOSS,i,t}$, $f_{PRJ,BUCKINGLOSS,i,t}$
Data unit	unitless ($0 < f_{BSL,BUCKINGLOSSi,t}$ $f_{PRJ,BUCKINGLOSS,i,t} < 1$)
Description	The proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	CBM-CFS3 EU-AIDB default values for SPU 3
Value applied:	CBM-CFS3 EU-AIDB default values for SPU 3
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,SNAGFALLDOWN,i,t}$, $f_{PRJ,SNAGFALLDOWN,i,t}$
Data unit	unitless ($0 < f_{BSL,SNAGFALLDOWNi,t}$ $f_{PRJ,SNAGFALLDOWN,i,t} < 1$)
Description	The proportion of snag biomass in polygon, i, year, t, that falls over, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3-EU-AIDB.
Value applied:	Variable, depending on species and dbh. Modeled by species and age class within CBM-CFS3 EU-AIDB

Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,LWDECAY,i,t}$, $f_{PRJ,LWDECAY,i,t}$
Data unit	unitless ($0 < f_{BSL,LWDECAYi,t}$ $f_{PRJ,LWDECAY,i,t} < 1$)
Description	The annual proportional loss of lying dead biomass due to decay, in polygon i, year, t in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3-EU-AIDB.
Value applied:	CBM-CFS3 default values for SPU 3
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,SWDECAY,i,t}$, $f_{PRJ,SWDECAY,i,t}$
Data unit	unitless ($0 < f_{BSL,SWDECAYi,t}$ $f_{PRJ,SWDECAY,i,t} < 1$)
Description	The proportional loss of snag biomass due to decay, in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3-EU-AIDB.
Value applied:	CBM-CFS3 default values for SPU 3

Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,DBGDECAY,i,t}$, $f_{PRJ,DBGDECAY,i,t}$
Data unit	unitless ($0 < f_{BSL,DGBDECAYi,t}$ $f_{PRJ,DBGDECAY,i,t} < 1$)
Description	The proportional loss of dead belowground biomass due to decay, in polygon i, year, t, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3-EU-AIDB.
Value applied:	CBM-CFS3 default values SPU 3
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$P_{3\text{-year}}$ and $P_{100\text{-year}}$
Data unit	unitless
Description	The proportion of total carbon stored in wood products after 3 years ($P_{3\text{-year}}$); and the proportion of harvested wood stored for 100 years ($P_{100\text{-year}}$), for product type, *k*.
Source of data	Calculated for the baseline and project case
Value applied:	$P_{3\text{-year}}$ = 0.495 (softwood saw log) $P_{100\text{-year}}$ = 0.095 (softwood saw log)

Justification of choice of data or description of measurement methods and procedures applied	Smith, et al (2006) Table 6 – the Northeast Softwoods, Saw Logs and Pulpwood; along with the Northeast Hardwood tables were applied.
Purpose of Data	Calculation of harvested wood products
Comments	Westphalen - BSL HWP (Dec '22)v5 excel spread sheet

Data / Parameter	$P_{BSL,SLF}$, $P_{BSL,MLF}$, $P_{BSL,LLF}$
Data unit	unitless
Description	The short-lived fraction (P_{SLF}), medium-lived fraction (P_{MLF}), and long-lived fraction (P_{LLF}), respectively, for product type, *k*
Source of data	Calculated as per equations 22a-c (baseline) and equations 50a-c (project)
Value applied:	$P_{BSL,SLF}$ = 0.505 (softwood saw log), 0.683 (softwood pulp), 0.5 (hardwood saw log), 0.504 (softwood pulp) $P_{BSL,MLF}$ = 0.40 (softwood saw log), 0.311 (softwood pulp), 0.465 (hardwood saw log), 0.393 (softwood pulp) $P_{BSL,LLF}$ = 0.095 (softwood saw log), 0.006 (softwood pulp), 0.035 (hardwood saw log), 0.103 (softwood pulp)
Justification of choice of data or description of measurement methods and procedures applied	Smith, et al (2006) Table 6 – the Northeast Softwoods, Saw Logs and Pulpwood; along with the Northeast Hardwood tables were applied.
Purpose of Data	Calculation of harvested wood products
Comments	Westphalen - BSL HWP (Dec '22)v5 excel spread sheet

Data / Parameter	$f_{TRANSPORTk}$
Data unit	(unitless; $0 \leq f_{BSL,TRANSPORTk} < 1$).
Description	The fraction of raw material transported by transportation type, *k*.

Source of data	Buyer/ Log sale history (2016-2021). Harvest history (all material is transported by truck)
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	Buyer/ Log sale history (2016-2021). Harvest history (all material is transported by truck)
Purpose of Data	
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$C_{HARVEST}$
Data unit	t C emitted/t C raw material
Description	The carbon emission intensity factor associated with harvesting
Source of data	Default values in VM0012 Table 4 have been used
Value applied:	0.016
Justification of choice of data or description of measurement methods and procedures applied	Default values in VM0012
Purpose of Data	
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$C_{MANUFACTURE k}$
Data unit	t C emitted/t C raw material
Description	The carbon emission intensity factor associated with manufacture of product, k

Source of data	Default values in VM0012 Table 4 have been used
Value applied:	0.04
Justification of choice of data or description of measurement methods and procedures applied	Buyer/ Log sale history (2016-2021). Harvest history (all material is manufactured as sawnwood)
Purpose of Data	
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$c_{TRANSPORTk}$
Data unit	t C emitted/t C raw material ● km
Description	The carbon emission intensity factor associated with the transport of raw material by transportation type of product, k
Source of data	Default values in VM0012 Table 4 have been used
Value applied:	0.00007
Justification of choice of data or description of measurement methods and procedures applied	Default values in VM0012
Purpose of Data	
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$d_{TRANSPORTk}$
Data unit	km
Description	The distance transported by transportation type, *k*.
Source of data	Buyer/ Log sale history (2016-2021)

Value applied:	68.8km
Justification of choice of data or description of measurement methods and procedures applied	Weighted average haul distance based on Buyer/ Log sale history (2016-2021)
Purpose of Data	
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$C_{EMITTRANSPORT,t}$
Data unit	t C yr^{-1}
Description	The annual fossil fuel emissions associated with the transport of raw material
Source of data	
Value applied:	Changes annually see spreadsheet
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Equation 26*
Comments	Emissions_BSL_Estimate (Dec '22)v2 spreadsheet

Data / Parameter	$\Delta C_{HWP,t}$
Data unit	t C yr^{-1}
Description	The annual change in carbon stocks in harvested wood products for year, *t*
Source of data	Calculated in equation 18 (Section 8.1); equation 46 (Section 8.2)
Value applied:	Changes annually see spreadsheet

Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	
Comments	Westphalen Final GHG Estimate Spreadsheet
Data / Parameter	E_M
Data unit	%
Description	An estimate of model error based on the relative area-weighted difference between model-predicted values of carbon storage and those values measured in field plots.
Source of data	Model output and field data (see Equation 60a).
Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of Uncertainty.
Comments	

Data / Parameter	E_I
Data unit	%
Description	An estimate of Inventory sampling error calculated as the 90% confidence limit of the area-weighted differences between the model-predicted values of carbon storage and those values measured in field plots.
Source of data	Model output and field data (see Equation 60c).
Value applied:	Percent Calculated

Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of Uncertainty.
Comments	

Data / Parameter	E_P
Data unit	%
Description	An estimate of total project error used to determine the uncertainty factor.
Source of data	Model output and field data (see Equation 60f).
Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of Uncertainty.
Comments	

Data / Parameter	$E_{Ry,ERR}$,
Data unit	%
Description	The uncertainty factor calculated for year 'y' (See Section 7.5).
Source of data	Model output and field data (see Equation 60f).
Value applied:	%
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.

Purpose of Data	Calculation of baseline and project emissions and calculations of VCUy.
Comments	

Data / Parameter	MLF_y
Data unit	%
Description	The market leakage factor determined for year 'y'
Source of data	Determined based upon the approach defined in Section 5.3
Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using the MARketz Tool as detailed in the appendices.
Purpose of Data	Calculation of leakage.
Comments	

Data / Parameter	Component Ratio Method (Biomass Expansion Factors).
Data unit	Unitless
Description	Used to convert height and DBH into biomass of component pools. Utilized to calculate biomass measured in field plots.
Source of data	Modeled by CBM-CFS3.
Value applied:	CBM-CFS3 default settings for SPU 3
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.

Comments	

6.2 Data and Parameters Monitored

Data / Parameter	$A_{PRJ,i}$
Data unit	Hectares (ha)
Description	Area of forest land in polygon, i
Source of data	Latest version of the spatial inventory data.
Description of measurement methods and procedures applied	GIS inventory data updated annually from Remote Sensing data, GPS data, combined with Westphalen forest inventory spreadsheets. Updated yearly by Project Proponent, monitored by the Project Developer.
Frequency of monitoring/recording	Prior to every verification period. Yearly for spatial change monitoring.
Value applied:	Inventory data, hectares.
Monitoring equipment	Visual, satellite, aerial photos, GPS survey data.
QA/QC procedures applied	Standard GIS QA/QC procedures. Zimmfor Management Services Ltd. – Greenhouse Gas Monitoring Standard Operating Procedures (SOP).
Purpose of data	Calculation of project emissions in project area instances.
Calculation method	GIS software processes calculate areas.
Comments	Includes delineation of project areas and polygons

Data / Parameter	$APSP_{,i}$,
Data unit	Hectares (ha)

Description	Area of permanent sample plot in polygon, i
Source of data	Field measurement.
Description of measurement methods and procedures applied	Fixed radius permanent sample plot design. See Zimmfor Management Services Ltd Greenhouse Gas Monitoring SOP for procedures applied for plot sampling procedures. Completed by Project Developer.
Frequency of monitoring/recording	Plot measurements are repeated on 5-year intervals.
Value applied:	See compiled plot data MS Excel File. Plot is recorded in m^2 and converted to hectares.
Monitoring equipment	GPS, measuring tape. ZEB GeoSLAM Horizon LiDAR Scanner
QA/QC procedures applied	GPS of plot center. Zimmfor Management Services Ltd. Standard Operating Procedures (SOP) followed, including QC/QA plot check processes.
Purpose of data	Required for calculations of mean aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured
Comments	

Data / Parameter	$DBH_{i,t}$
Data unit	Centimeters (cm)
Description	Diameter at breast height measured for each tree in the sample plot at time, t
Source of data	Field measurements in sample plots.
Description of measurement methods and procedures applied	Field measurements in permanent sample plots. Measurement with ZEB GeoSLAM Horizon LiDAR Scanner trees ≥ 5cm in DBH at 1.3m height above ground. Completed by Project Developer.

Frequency of monitoring/recording	Individual plot tree re-measurements are repeated on 5-year intervals.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	ZEB GeoSLAM Horizon LiDAR Scanner, DBH tape, data logger
QA/QC procedures applied	Zimmfor Service Management Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for calculations in aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured.
Comments	

Data / Parameter	$Height_{i,t}$
Data unit	Meters (m)
Description	Tree height measured for each tree in the sample plots at time, t
Source of data	Field measure in sample plots.
Description of measurement methods and procedures applied	Field measurements in permanent sample plots. Measurement with ZEB GeoSLAM Horizon LiDAR Scanner to for trees ≥ 5cm DBH. Completed by Project Developer.
Frequency of monitoring/recording	Individual plot tree re-measurements are repeated on 5-year intervals.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	ZEB GeoSLAM Horizon LiDAR Scanner, or other instrument designed for the measuring height.
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).

Purpose of data	Required for calculations of mean aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured
Comments	

Data / Parameter	$B_{AG\ i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Aboveground live tree biomass in polygon, i, year, t, in the project.
Source of data	Permanent sample plots (PSP).
Description of measurement methods and procedures applied	Calculated from $Height_{i,t}$, $DBH_{i,t}$, and $APSP_i$, Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Above ground biomass for each permanent sample plot will be calculated using m^3/ha and supporting CBM-CFS3 data (Boudwyn 2007 equations).
Comments	Calculated

Data / Parameter	$B_{BG\ i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Average belowground live tree biomass in polygon, i, year, t, in the project.
Source of data	Estimated using info from above ground biomass calculations within permanent sample plots from $B_{AGi,t.}$
Description of measurement methods and procedures applied	Calculated using plot data in CBM-CFS3 EU-AIDB. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Below ground biomass for each permanent sample plot will be calculated using m^3/ha and supporting CBM-CFS3 data (Boudwyn 2007 equations).
Comments	

Data / Parameter	$B_{TOTAL\ i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Average total live biomass in polygon, i, for year, t.
Source of data	Derived from average above and below ground biomass calculations within permanent sample plots.

Description of measurement methods and procedures applied	Sum of $B_{AGi,t}$ and $B_{BGi,t}$. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	Calculated using plot data and supporting CBM-CFS3 data (Boudwyn 2007 equations).
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for above and below ground living tree biomass and in the determination of Uncertainty Factor.
Calculation method	Sum of $B_{AGi,t}$ and $B_{BGi,t}$ values.
Comments	Calculated

Data / Parameter	$CLB_{i,t}$
Data unit	t d.m. ha-1 (d.m. = dry matter)
Description	Total carbon storage in live tree biomass in polygon, i, year, t, tC in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from $B_{TOTALi,t}$ and CF, sum of $B_{AG\ i,t}$ and $B_{BG,\ i,\ t}$. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	

QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	As calculated by supporting CBM-CFS3 data (Boudwyn 2007 equations). and plot data, or $B_{TOTALi,t}$ * CF
Comments	

Data / Parameter	$CDOM_{i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Total carbon storage in dead organic matter in polygon, i, year, t,
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from $DOM_{SNAGi,t}$ and $DOM_{LDWi,t}$ and CF. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	As calculated from plot data, decay rate constraints and supporting CBM-CFS3 data (Boudwyn 2007 equations). Or ($DOM_{SNAGi,t}$ + $DOM_{LDWi,t}$)* CF
Comments	Calculated

Data / Parameter	$f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 < f_{PRJ,NATURAL,i,t} < 1$)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the project scenario.
Source of data	Permanent sample plots, remote sensing.
Description of measurement methods and procedures applied	The height and dbh of dead trees in permanent sample plots will be recorded. Areas of stand replacing natural disturbance events will be delineated if >1.0 hectares. Completed by Project Developer.
Frequency of monitoring/recording	Annually in the case of natural disturbance events, every 5 years in the case of individual plot trees
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Observation
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for project calculations
Calculation method	Observation in plot, and/or calculated by supporting CBM-CFS3 data (Boudwyn 2007 equations) and/or GIS/GPS delineation.
Comments	

Data / Parameter	$f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 < f_{PRJ,HARVEST,i,t} < 1$)
Description	The proportion of biomass removed by harvesting from polygon, i, in year, t, in the project scenario.
Source of data	Project Proponent harvesting records, inventory data.

Description of measurement methods and procedures applied	Volume derived from harvesting records. Modeled estimates of total biomass in polygon, i, used to derive parameter. Completed by Project Proponent.
Frequency of monitoring/recording	Annually
Value applied:	See harvest area.
Monitoring equipment	GPS, remote sensing
QA/QC procedures applied	Data will be verified by ground-truthing and comparison with remote sensing information.
Purpose of data	Required for project calculations.
Calculation method	Modeled by CBM-CFS3 based on actual removals.
Comments	

Data / Parameter	$f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of additional biomass removed for road and landing construction in polygon, i, year, t, in the project case.
Source of data	Remote sensing, inventory data.
Description of measurement methods and procedures applied	Removals derived from remote sensing data and construction records. Completed by Project Proponent yearly.
Frequency of monitoring/recording	Annually
Value applied:	See GIS delineations construction records.
Monitoring equipment	GPS, satellite imagery, aerial photos,

QA/QC procedures applied	Data will be verified by ground-truthing and comparison with remote sensing information.
Purpose of data	Required for project calculations.
Calculation method	Areal estimate of removals is multiplied by average carbon density within a polygon.
Comments	

Data / Parameter	$DOM_{SNAG,i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Total mass of dead organic matter contained in standing dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from Height, $_{i,t}$, $DBH_{i,t}$, and $APSP_{,i}$ of dead trees measured in permanent sample plots. Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated by supporting CBM-CFS3 data (Boudwyn 2007 equations) from plot data.
Comments	Calculated

Data / Parameter	$DOM_{LDW,i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Total mass of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from the line intersect method (Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP)). Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated using the following field- measured parameters Li,t, dni,t, DLDWc,i,t , and N,t
Comments	Calculated

Data / Parameter	VLDW,i,t
Data unit	m3 ha-1
Description	Total volume of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.

Description of measurement methods and procedures applied	Calculated from the line intersect method (Zimmfor Management Services Ltd. Greenhouse Gas – Monitoring SOP). Completed by the Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Tape and visual inspection.
QA/QC procedures applied	Zimmfor Mangement Services Ltd Greenhouse Gas – Monitoring SOP.
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated using the following field- measured parameters $L_{i,t}$, $d_{ni,t}$, $D_{LDWc,i,t}$, and N_t
Comments	

Data / Parameter	$L_{i,t}$
Data unit	Meters (m)
Description	Calculation of lying dead wood: Length of the transect used to determine volume of lying dead wood in the sample plot, at time, t (4*25m=100m). Completed by Project Developer.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Field measurements
Frequency of monitoring/recording	Every 5 years.
Value applied:	100 meter transect
Monitoring equipment	Metric measuring tape.

QA/QC procedures applied	Zimmfor Mangement Services Ltd Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of carbon stocks and Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	$D_{n,i,t}$
Data unit	Centimeters (cm)
Description	Calculation of lying dead wood: Diameter of each piece n of dead wood inside the sample plot at time, t).
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Lying dead wood to be sampled as described in the Zimmfor Management Services Ltd Monitoring SOP. Four 25-m lines are established bisecting each plot on cardinal bearings (N,S,E,W) and specific diameters of the lying wood within three radius sizes intersecting the lines are measured. The minimum diameter must not be less than 5 cm. Completed by Project Developer
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Caliper, diameter tape
QA/QC procedures applied	Zimmfor Mangement Services Ltd Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	$N_{,t}$
Data unit	unitless
Description	Calculation of lying dead wood: Diameter of each piece n of dead wood along the in the sample plot at time, t).
Source of data	Permanent sample plots field measurement.
Description of measurement methods and procedures applied	Total number of wood pieces in the sample plot, in time t, Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Visual observation.
QA/QC procedures applied	Zimmfor Mangement Services Ltd Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	E_M / Mean model error for the project
Data unit	%
Description	An estimate of model error.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated value determined difference between of model-predicted values of carbon storage and those values measured in field plots (see Equation 60a). Completed by

	Project Developer.
Frequency of monitoring/recording	At each verification.
Value applied:	-0.26%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Equation (60a).
Comments	

Data / Parameter	E_I / Inventory error for the project
Data unit	%
Description	An estimate of inventory sampling error.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated as the 90% confidence limit of the area-weighted differences between the model-predicted values of carbon storage and those values measured in field plots. Completed by Project Developer.
Frequency of monitoring/recording	At each verification.
Value applied:	0.21%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.

Calculation method	Equation (60c).
Comments	

Data / Parameter	E_P / Estimated project error
Data unit	%
Description	An estimate of total project error calculated as the sum of the model and inventory error terms.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated as the sum of EM and EI (Equation 60e). Completed by Project Developer.
Frequency of monitoring/recording	At each verification.
Value applied:	-0.05%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Equation (60f).
Comments	

Data / Parameter	$ER_{y,ERR}$ / Uncertainty Factor
Data unit	%
Description	The uncertainty factor calculated for year 'y'
Source of data	Model output and field data.

Description of measurement methods and procedures applied	Calculated value. Completed by Project Developer.
Frequency of monitoring/recording	At each verification and applied annually until the next verification.
Value applied:	1.5 %
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for project calculations.
Calculation method	
Comments	

Data / Parameter	MLF_y
Data unit	Percent
Description	The market leakage factor determined for year 'y'
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Determined based upon the approach defined in Section 3. Completed by Project Developer.
Frequency of monitoring/recording	At each verification
Value applied:	20%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for calculation of leakage.

Calculation method	Value determined using the MARketz Tool as detailed in the appendices.
Comments	

6.3 Monitoring Plan

The objective of the Westphalen Forest Carbon Project monitoring plan is to reliably monitor changes in carbon stocks related to the calculation of VCU's prior to each verification. In particular, the program will reliably monitor changes in spatial forest inventory conditions and collect field data on carbon stocks (as per Zimmfor Management Services Ltd. Monitoring Standard Operating Procedures (SOP)) to compare against modeled carbon stocks and to calculate the uncertainty factor.

Ongoing monitoring is the primary operational task for the project, which will be completed by the Project Proponent and supported by the Project Developer and Implementation Partner. Additional field monitoring may require the hiring of external field crews, all of which will be experienced in forest mensuration. The Project Proponent's onsite supervisor, Project Developer and Implementation Partner will be responsible for the adequate training of these external contractors, ensuring that all individuals involved are familiar with the sampling standard operating procedures.

At each verification, reported on an annualized basis, the project will make the following inventory updates, as applicable:

1. Collect geo-referenced information on new project activities, including any forest management or silvicultural activities on any project instance that materially affects GHG emissions.
2. Annually monitor for forest disturbances through remote sensing, field observation, and/ or aerial observation and incorporate into GIS systems.

The inventory will be updated at a minimum, for:

- Natural disturbance events > 4 hectares (for example, fires, high mortality pest and disease areas, blowdown areas, slides, etc.).
- Project activities (e.g., timber harvesting/ thinning, road construction/ reclamation, reforestation/restoration, etc.). A minimum polygon size of 1 hectare can be used but is not a mandatory minimum.
- Unplanned anthropogenic disturbances (for example, non-de minimis illegal or unplanned harvests) affecting a non-de minimis amount of carbon stocks.

These monitored spatial elements will be updated in the project GIS inventory database and the Westphalen inventory database (or equivalent) annually, or at minimum at each verification on an annualized basis.

6.3.1 Other Monitoring Requirements:

The Project Proponent will also document the following:

1. Activity shifting leakage (monitored annually, reported at each verification) – the project will report and assess the activity shifting leakage risks based on the timber harvest levels on lands owned or controlled by Westphalen that are outside the project area.
2. Market leakage calculations (at each verification, applied annually) - market leakage calculations will be confirmed at each verification using the latest plot inventory data and best available regional leakage area analysis.
3. Loss events (monitored annually as per Zimmfor Management Services Ltd SOP, reported as per VCS Standard v4.4) - the project will monitor and report any deficits in carbon stock pools >5% of previously verified emissions, reductions, and removals.

At verification, the project will update the inventory, uncertainty calculations, and carbon calculations from field plot measurement data as outlined in Sections 6.3 and 7.3. The project may also undertake the following monitoring related tasks as appropriate:

1. Refine the project analysis units based on new forest inventory data or to meet the needs of future project instances.
2. Refine or calibrate carbon models based on updated inventory data, as appropriate.
3. Update or modify inventory polygons based on updated remote sensing, forest inventory data, or field truthing, or as a result of project activities or disturbances.

All inventory, data, and modeling changes must be applied equally to the baseline and project carbon calculations, as applicable.

6.3.2 Carbon Stock Field Plot Monitoring

The Westphalen Forest Carbon Project was initiated in 2018 with monitoring work completed in August of 2022. Plot data was collected using a ZEB Horizon 3D Point LiDAR unit and a geo-located plot network for monitoring changes in stand-level forest volume and merchantable timber. A total of 31 permanent monitoring sample plots were established within 8 analysis units. See table below for locations.

Table 21: Permanent Sample Plot Locations

	Plot Location Coordinates GCS_WGS_84 (decimal degrees)		
Plot Number	Analysis Unit	North	East
BZ1-1	BZ1	54.199	10.442
BZ1-2	BZ1	51.345	8.249
BZ1-3	BZ1	51.640	8.853
BZ1-4	BZ1	51.516	9.305
BZ1-5	BZ1	54.229	10.485
BZ1-6	BZ1	51.686	8.898
BZ2-1	BZ2	51.694	8.897
BZ2-2	BZ2	51.694	8.894
BZ2-3	BZ2	51.657	8.862
BZ2-5	BZ2	54.217	10.471
BZ2-6	BZ2	54.212	10.471
BZ2-7	BZ2	51.686	8.902
BZ2-8	BZ2	51.649	8.852
BZ2-9	BZ2	54.046	10.484
BZ3-1	BZ3	51.468	8.764
BZ3-2	BZ3	51.659	8.866
BZ3-3	BZ3	54.065	10.348
BZ3-4	BZ3	51.468	8.778
BZ3-5	BZ3	54.055	10.417
BZ3-6	BZ3	51.461	8.780

	Plot Location Coordinates GCS_WGS_84 (decimal degrees)		
Plot Number	Analysis Unit	North	East
BZ3-7	BZ3	54.220	10.460
OZ1-1	OZ1	51.503	8.823
OZ1-2	OZ1	51.503	8.826
OZ2-1	OZ2	51.668	8.918
OZ2-2	OZ2	51.675	8.951
OZ3-1	OZ3	54.208	10.417
OZ3-2	OZ3	51.674	8.949
SZ1-1	SZ1	51.516	9.292
SZ1-2	SZ1	51.515	9.288
SZ2-1	SZ2	54.179	10.449
SZ2-2	SZ2	51.512	9.277

All historical and Westphalen Forest Carbon Project monitoring to date has been incorporated into the property inventory and GIS data updates used in this project design document.

The plot monitoring program for carbon stocks established new permanent sample plots within the analysis units. At each plot over story trees, dead standing trees, and lying deadwood data were collected. As part of ongoing project monitoring, the project will periodically review the need for additional permanent sample plots or incorporation of other forest and carbon inventory updates or improvements over time. The methodology does not specify a number of plots, errors over the target (10% @ 90%CI) would be accounted for in the uncertainty factor deduction (Section 7.5).

6.3.3 Monitoring Carbon Plot Sampling Design Overview:

The establishment of permanent monitoring sample plots (PSPs) was initiated in 2022 by the Project Proponent. A total of 31 PSPs were planned for establishment distributed among 8 analysis units within the project area. Plot monitoring and measuring techniques were completed as per the Zimmfor Management Services Ltd. Greenhouse Gas Monitoring SOP.

Plot Layout - Permanent plot locations were located using UTM coordinates randomly selected via GIS analysis tools. A minimum buffer distance of 50m was also implemented between plots to ensure appropriate spatial distribution.

Size and shape of sample plots – Permanent sample plots will be circular with a fixed radius of 11.28m ($400m^2$).

Plot measurements – plots are installed, measured, and will be re-measured following the latest version of the Zimmfor Management Services Ltd. – Greenhouse Gas Monitoring SOP) for carbon accounting in specific portions of Westphalen's managed lands. Plot measurements include live trees (aboveground live biomass); standing dead trees (aboveground dead biomass); and lying dead wood (aboveground dead biomass).

Given the dynamics of forest processes, the permanent plots will be re-measured at intervals not exceeding 5 field season years, beginning upon year of installation. As noted, permanent plots may be established over multiple years, and such re-measurement schedules will be tracked for each plot based on establishment year.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	$A_{PRJ,i}$
Data unit	Hectares (ha)
Description	Area of forest land in polygon, i
Value applied:	772 ha
Comments	Total area of project instances for this monitoring period.

Data / Parameter	$A_{PSP,i}$,
Data unit	Hectares (ha)
Description	Area of permanent sample plot (PSP) in polygon, i
Value applied:	1.24 ha With use of the plot multiplier the hectares are used for calculation in Uncertainty Factor.
Comments	Calculated statistical uncertainty in forest carbon inventories compared to CBM CFS3 EU AIDB model outputs.
Data / Parameter	DBH $_{i,t}$
Data unit	Centimeters (cm)
Description	Diameter at breast height measured for each tree in the sample plot at time, t
Value applied:	See compiled plot data MS Excel File.

Comments	Diameters measured in each permanent sample plots contribute to factors used to calculate above ground carbon stores measured in analysis unit plot observations. Captured via LiDAR.

Data / Parameter	Height $_{i,t}$
Data unit	Meters (m)
Description	Tree height measured for each tree in the sample plots at time, t
Value applied:	See compiled plot data MS Excel File.
Comments	Tree heights measured in each permanent sample plot contribute to parameters used to calculate above ground carbon stores measured in analysis unit plot observations. Captured via LiDAR.

Data / Parameter	$B_{AG\ i,t}$
Data unit	t d.m. ha-1 (d.m. = dry matter)
Description	Aboveground live tree biomass in polygon, i, year, t, in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of above ground live tree biomass carbon stocks (Height, DBH, APSP,i) Parameters used for uncertainty calculations.

Data / Parameter	$B_{BG\ i,t}$
Data unit	t d.m. ha-1 (d.m. = dry matter)
Description	Average belowground live tree biomass in polygon, i, year, t, in the project.

Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of below ground tree biomass carbon stocks, Parameters used for uncertainty calculations.

Data / Parameter	$B_{TOTAL\ i,t}$
Data unit	t d.m. ha-^{1} (d.m. = dry matter)
Description	Average total above and below ground live biomass in polygon, i, for year, t.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of above and below ground tree biomass carbon stocks, Parameters used for uncertainty calculations. Sum of BAGi,t and BBGi,t.

Data / Parameter	$C_{LB\ i,t}$
Data unit	t d.m. ha-^{1} (d.m. = dry matter)
Description	Total carbon storage in live tree biomass in polygon, i, year, t, tC in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of live tree biomass carbon stocks, parameters used for Uncertainty calculation.

Data / Parameter	$C_{DOM\ i,t}$
Data unit	t d.m. ha-^{1} (d.m. = dry matter)
Description	Total carbon storage in dead organic matter in polygon, i, year, t,
Value applied:	See compiled plot data MS Excel File.

Comments	Annual change in dead organic matter carbon stocks. Parameters used in uncertainty calculation.

Data / Parameter	$f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 < f_{PRJ,NATURAL,i,t} < 1$)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Annual change in natural mortality in carbon stocks. Factor in uncertainty calculation.

Data / Parameter	$f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 < f_{PRJ,HARVEST,i,t} < 1$)
Description	The proportion of biomass removed by harvesting from polygon, i, in year, t, in the project scenario.
Value applied:	Volumes, modeled by CBM-CFS3 based on actual removals.
Comments	Parameters used for project emission calculations.

Data / Parameter	$f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of biomass removed for road and landing construction in polygon, i, year, t, in the project case.
Value applied:	Volumes, based on monitored removals. Change in carbon stocks annually.
Comments	Parameters used for project emission calculations.

Data / Parameter	$DOM_{SNAG,i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Total biomass of dead organic matter in standing dead wood in polygon, i, year, t in the project scenario.
Value applied:	Change in carbon stock annually.
Comments	Parameters used for uncertainty calculations.

Data / Parameter	$DOM_{LDW,i,t}$
Data unit	t d.m. ha^{-1} (d.m. = dry matter)
Description	Total mass of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used for uncertainty calculations.

Data / Parameter	VLDW,i,t
Data unit	m3 ha-1
Description	Total volume of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Value applied:	See complied plot data MS Excel File
Comments	Parameters used in Uncertainty calculation.

Data / Parameter	$L_{i,t}$

Data unit	m
Description	Used in calculation of mean mass of dead organic material, lying dead wood: Length of the transect used to determine volume of lying dead wood in the sample plot, at time, t (4*25m=100m)
Value applied:	100m transect
Comments	Parameters used in uncertainty calculations.

Data / Parameter	$D_{n,i,t}$
Data unit	cm
Description	Diameter of each piece n of dead wood along the transects in the sample plot at time, t). Used in calculation of lying dead wood
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used in uncertainty calculations.

Data / Parameter	$N_{,t}$
Data unit	unitless
Description	Calculation of dead organic material. Diameter of each piece n of dead wood along the transects in the sample plot at time, t).
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used in uncertainty calculations.

Data / Parameter	E_M / Mean model error for the project
Data unit	%

Description	An estimate of model error.
Value applied:	-0.26 %
Comments	Equation (60a).

Data / Parameter	E_I / Inventory error for the project
Data unit	%
Description	An estimate of inventory sampling error.
Value applied:	0.21%
Comments	Equation (60c).

Data / Parameter	E_P / Estimated project error
Data unit	%
Description	An estimate of total project error calculated as the sum of the model and inventory error terms.
Value applied:	-0.05%
Comments	Equation (60f)

Data / Parameter	$ER_{y,ERR}$ / Uncertainty Factor
Data unit	%
Description	The uncertainty factor calculated for year 'y'
Value applied:	1.5%
Comments	Parameters used in project emission calculations

Data / Parameter	MLF_y
Data unit	Percent
Description	The uncertainty factor calculated for year 'y'
Value applied:	0%
Comments	Parameters used in leakage calculations

7.2 Baseline Emissions

7.2.1 Overview of Baseline and Project Scenarios Using CBM-CFS3 Outputs and Microsoft Excel Applications

The Project Proponent's management plans, the CBM-CFS3 EU-AIDB model and supporting Excel spreadsheets were developed to house data, and to perform carbon modeling by PAI. Data from the CBM-CFS3 output 'Delta Ecosystem Reports' were exported into excel spreadsheets for further analysis consistent with the VM0012 methodology. The reports consist of tables that contain the applicable carbon pools and include reference equations as presented in the methodology. Modelling covers all analysis units in both the project and baseline scenarios.

The Management Plans cover and adequately represent all PAIs and reflects the real-world operational environment and meets legal requirements. The Rixdorf and the NRW Management Plans were used to produce the Baseline Scenario. This included detailed Polygon-based Forest inventory data with thinning and final felling rates (volumes) along with stand attributes for all PAIs.

Stand management is as per the 'Silvicuture Patterns Graf von Westphalen' that is species and age specific but generally includes: standing tending, pre-commercial thinning, thinning (1-2 times within 10 years) along with final felling or diameter limited felling.

The polygon-based forest inventory data was then used to populate CBM-CFS3 input files (i.e., classifiers, age classes, disturbance types, events, inventory, and transitions). Each polygon included sufficient information (Classifiers/ Themes) to allow filtering into assigned Analysis Unit (Table 18: Description of Forest Analysis Units Defined in the Project Area).

Classifiers were used in combination with polygon area to match up the inventory polygon to the correct carbon yield curve. The CBM-CFS3 derived stand and carbon curves are modeled on an assumed fully stocked representative stand in each AU and applies carbon and merchantable volume outcomes for each polygon based on the applicable allometric formulas. The model includes discrete 'Runs' that represent the project (PRJ - curtailed harvest) and specific baseline disturbances/ harvest activities (BSL – harvest).

Equations used may be referenced within the section or noted in Appendix 5 of this document.

The CBM-CFS3 model then simulates and tracks the flux of carbon in all applicable carbon pools over time by polygon, including transfers to the Wood Products pool after any scheduled event. Carbon calculations can then be summarized for the project and baseline scenarios for each project year across all project instances.

Baseline emissions are calculated by applying a Baseline 'disturbances' to each AU, and then modeling the baseline activities and the related carbon flows using CBM-CFS3. The methods described are equivalent to the equations and processes outlined in VM0012.

7.2.2 Calculating Baseline Scenario Live Biomass Gain

For the Historic Baseline Scenario (as described in Section 3.4), a set of historic baseline activities (disturbances) was based on harvest details within the Management Plans. The annual harvest volume has been determined by forward looking harvest volumes and are driven by site productivity, desired products mix and limited by legal constraints. All baseline management activities are assumed to occur/ begin at year 1 (2018).

Live biomass gain ($\Delta C_{BSL,G,t}$, Eqn 4,5a-b) is calculated by CBM-CFS3 based on the project area (instances) & stratifications into analysis units. Regionally specific forest dynamics (Northrein_Westfalen), and the related carbon curves discussed above, are tracked, and reported by carbon pool (e.g. Aboveground Live & Belowground Live) and reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009).

7.2.3 Calculating Baseline Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{BSL,L,t}$, Eqn 6, 7, 8, 9) is calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dynamics, including natural tree mortality, harvesting scenario felling/ removals, blowdown, and any other biomass loss. Generally, mortality related live biomass is shifted into dead biomass pools by CBM-CFS3 (Aboveground Standing Dead (snags), Aboveground Downed and Dead Wood (DOM), Belowground DOM), which are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009).

7.2.4 Calculating Baseline Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{BSLDOM,t}$, Eqn 10, 11a-b, 12, 13, 14a-b, 15, 16, 17a-d) are calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dead wood dynamics, including standing dead, downed dead, and below ground dead organic matter. CBM-CFS3 uses the regionally specific variant data and related parameters to model and track dead organic matter between carbon pools (Aboveground Dead (i.e. Stem Snags), Belowground Dead, Aboveground Slow DOM (VM0012 calls this Lying Dead Wood)). Decay and transfer between pools is related to regional temperate.

Additionally, CBM-CFS3 tracks dead organic matter dynamics related to harvesting (slash) or other events when applied. The project uses the default decay factors and dead matter dynamics that are set within the CBM-CFS3 model and specific to the variant dataset. The results of dead organic matter dynamics are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et. al.* (2009). Generally, carbon stocks are transitioned between dead biomass pools, and emitted as they decay.

7.2.5 Calculating Baseline Scenario Harvested Wood Products (HWP)

Harvested Wood Product dynamics ($\Delta C_{BSLHWP,t,}$ Eqn. 18, 19, 20 (not used), 21, 22a-c, 23) are calculated from CBM-CFS3 using an export of the Ecosystem Transfers pools for Softwood and Hardwood Harvest (transfer of carbon from the merchantable biomass pools to the forest products sector).

For the purposes of Step 2 (carbon contained in harvested timber after milling) Forest Product Conversion Factors for the UNECE Region published by the United Nations Economic Commission for Europe (ECE/TIM/DP/49) was used to determine the total carbon in harvested timber that will enter the wood products pool by product type accounting for mill efficiencies and estimated product disposition percentages ($C_{BSL,MILL,h}$; t C). The gross quantity of carbon contained in harvested timber for each of the four product types (k) described in Step 1 must be decremented to account for losses during processing. This loss is calculated within Westphalen - BSL HWP (Dec '22)v5 excel spread sheet specifically tab 'Step 2 (Mill)'. Refer to the Appendices for additional information.

Step 3 calculates (carbon storage in medium-term and long-term wood products) the total carbon lost in short-lived products and stored in medium-term and long-term products. Calculations were completed as per the methodology and using reference tables and factors from Smith, et al (2006). The result is a fraction of the Wood Products pool being emitted or stored annually for each 'In-Use' category based on product, decay, and storage factors.

Constants from Smith, et al (2006) Table 6 – the Northeast Softwoods, Saw Logs and Pulpwood; along with the Northeast Hardwood tables were applied. The respective volumes were calculated by species and product type. Constants were from the relevant "In Use" column were used to finalize calculations for the following HWP categories:

- Short-lived HWP – multiplied (Year 1 – 3 look-up factor) for each of the tables against the respective remaining In-Use carbon volumes. This calculates the fraction of net Merch Carbon Removed that is In-Use as Short-lived HWP. Following VM0012, the sum of all Short-lived HWP is assumed to be emitted immediately.
- Long-lived HWP – applied the look-up factor for Year 100 for each of the tables against the respective remaining In-Use carbon volumes. This calculates the fraction of net Merch Carbon Removed that is In-Use as Long-lived HWP. Following VM0012, the sum of all Long-lived HWP is assumed to be permanently stored.
- Medium-Lived HWP – the difference between the carbon remaining In-Use at Year 3 and at Year 100 is then calculated using each table look-up factors and carbon volumes, respectively to calculate the Medium-lived HWP. The sum of all Medium-Lived HWP is then modelled to emit on a straight line 20-year decay curve, starting in year 0 and being fully emitted in year 20.

Note that the remaining Merch Carbon Removed after accounting for Short-, Medium-, and Long-lived HWP is emitted immediately as a combination of emissions due to waste carbon being Emitted without Energy.

Resulting values may be located in the Appendix.

7.2.6 Fossil fuel emissions associated with logging, transport, and manufacture

Westphalen has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions ($\Delta CBSL_{,EMITFOSSIL,t}$, Eqn. 24, 25, 26, 27) from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., thinning, or clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups).

Default values in VM0012 Table 4 have been used. All calculations in support of this are within: Emissions_BSL_Estimate (Dec '22)v2 spreadsheet. See Appendices.

A CBM-CFS3 output for the Softwood and Hardwood Harvest pools and along with historical product group distribution were used for the following calculations.

The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as:

$$C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t} \quad \text{(Eq. 24)}$$

Each of the carbon components are calculated as noted below:

<u>Equation 25:</u>

$C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr-1).

$$C_{BSL,EMITHARVEST,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet c_{HARVEST}$$

All timber in the Westphalen project is harvested via thinning and final fellings and the default value for $c_{HARVEST}$ is used.

Equation 26:

$C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr-1).

$$C_{BSL,EMITTRANSPORT,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet \Sigma(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk})$$

$f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; 0 < 1). All timber in the Westphalen project is transported by truck.

$d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km), Haul distances from the harvest area directly to customers. The boundaries of this emission calculation are from harvest area to the point of sale. Emissions distances do not include additional transport distances from the consumer to milling facilities when applicable. This is conservative in nature.

The transport distance is calculated using historical buyer overview (2016-2021) and a weighted average haul distance (km) for each customer.

$c_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k. The table 4 for default values are used.

Equation 27

$C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr-1).

$$C_{BSL,EMITMANUFACTURE,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet \Sigma(f_{BSL,PRODUCTk} \bullet c_{MANUFACTUREk})$$

$C_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k.

The following product groups from harvest groups and species were assigned to the following product type (k) categories: fuelwood and saw logs (softwood, hardwood).

For saw logs product type (k) the table 4 for default values are used. Fuel wood was assigned a 0 value for manufacturing as it is deemed *de-minimus*.

7.2.7 Baseline Scenario GHG Emissions Calculation Summary

The CBM-CFS3 model and supporting spreadsheets were used based on spatial forest inventory data to calculate and track all annual changes in both the live biomass ($\Delta C_{BSL,LB,t}$) and dead organic matter pools (($\Delta C_{BSL,DOM,t}$) for the baseline scenario in a method consistent with the formulas in VM0012. Carbon storage changes in harvested wood products ($\Delta C_{BSl,HWP,t}$) and fossil fuel emissions ($\Delta C_{BSL,EMITFOSSIL,t}$) summarized net carbon balances, and other deductions and buffer discounts were determined in the supporting spreadsheets.

The total annual carbon balance in year, t, for the baseline scenario (ΔCBSL,t, in t C yr-1) was calculated as:

$\Delta C_{BSL,t} = \Delta C_{BSL,P,t}$ (1)

where:

$\Delta C_{BSL,P,t}$ is the annual change in carbon stocks in all pools in the baseline across the project activity area (including all project instances); t C yr-1.

The annual change in carbon stocks in all pools in the baseline across the project activity area ($\Delta C_{BSL,P,t}$; t C yr^{-1}) was calculated as:

$\Delta C_{BSL,P,t} = \Delta C_{BSL,LB,t} + \Delta C_{BSL,DOM,t} + \Delta C_{BSl,HWP,t}$ (2)

where:

$\Delta C_{BSL,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr^{-1}

$\Delta C_{BSL,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr^{-1}

$\Delta C_{BSl,HWP,t}$ is the annual change in carbon stocks associated with harvested wood products, t C yr^{-1}.

The annual change in carbon stocks in living tree biomass (above- and belowground) in the baseline scenario ($\Delta C_{BSL,LB,t}$; t C yr^{-1}) was calculated as:

$\Delta C_{BSL,LB,t} = \Delta C_{BSL,G,t} - \Delta C_{BSL,i,t}$ (3)

where:

$\Delta C_{BSL,G,t}$ = annual increase in tree carbon stock from growth; t C yr^{-1}

$\Delta C_{BSL,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr^{-1}.

The annual change in carbon stocks in dead organic matter (DOM) ($\Delta C_{BSL,DOM}$; t C yr^{-1}) in the baseline scenario was calculated as:

$\Delta C_{BSL,DOM,t} = \Delta C_{BSL,LDW,t} + \Delta C_{BSL,SNAG,t} + \Delta C_{BSL,DBG,t}$ (10)

where:

$\Delta C_{BSL,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr^{-1}

$\Delta C_{BSL,SNAG,t}$ = change in snag carbon stock in year, t; t C yr^{-1}

$\Delta C_{BSL,DBG,t}$ = change in dead below-ground biomass carbon stock in year, t; t C yr^{-1}.

The annual change in emissions associated with the production of harvested wood products (HWP), $\Delta C_{BSl,HWP,t}$, is calculated as:

$\Delta C_{BSl,HWP,t} = \Delta C_{BSL,STORHWP,t} - \Delta C_{BSL,EMITFOSSIL,t,}$ (18)

$\Delta C_{BSL,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr^{-1})

$\Delta C_{BSL,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.

Resulting values may be located in the Appendix.

7.3 Project Emissions

Project emissions and carbon flows are calculated in the same manner as the baseline emissions discussed in Section 5.1. Calculations use the same forest inventory data, analysis units and polygons, and modeling tools under the Project Scenario activities. Project and Baseline Scenarios and polygon versions of each are tracked and calculated simultaneously in the supporting spreadsheets using the same parameters, outputs, and analysis under each scenario. In the project scenario, carbon flows are modeled using project activities which includes the focus on maintaining forest health throughout the term of the project.

Project activities affecting GHG emissions were carried out during the initial project period (2018-2021) however, no project scenario activities were projected on an *ex-ante* basis. Future years may include various project forest management activities that affect *ex-post* carbon stocks which will be monitored and reported on in future verifications (e.g. salvage due to significant fire or forest health loss). Project activities will be based on actual monitoring results (see Section 6) and any resulting emissions netted against emission reductions.

The methods described are equivalent to the equations and processes outlined in VM0012.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

7.3.1 Calculating Project Scenario Live Biomass Gain

Live biomass gain ($\Delta C_{PRJ,G,t}$, Eqn 32,33a-b) is calculated the same as in the Baseline Scenario (CBM-CFS3-EU-AIDB), Section 7.2.2 using project area (instances), and analysis unit information.

7.3.2 Calculating Project Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{PRJ,L,t}$, Eqn 34,35,36,37) is calculated the same as in the Baseline Scenario (CBM-CFS3-EU-AIDB), Section 7.2.3 using project area stratifications, regionally specific forest dynamics and the related carbon curve data.

7.3.3 Calculating Project Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{PRJ,DOM,t}$, Eqn 38,39a-b,40,41,42a-b,43,44,45a-d) are calculated the same as in the Baseline Scenario, Section 7.2.4 using project scenario polygons and data.

7.3.4 Calculating Project Scenario Harvested Wood Products (HWP)

Harvested Wood Product dynamics ($\Delta C_{PRJ,HWP,t}$, Eqn 46,47,48,49,50a-c,51,52,53,54,55) are calculated the same as in the Baseline Scenario, Section 7.2.5 with respect to any timber harvesting in the project scenario. The Westphalen Forest Carbon Project will undertake ongoing low levels of management activities for forest maintenance, ecological enhancement, and/or risk mitigation.

7.3.5 Fossil fuel emissions associated with logging, transport, and manufacture

The Westphalen Forest Carbon Project has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions ($\Delta C_{PRJ,\ EMITFOSSIL,t}$, Eqn. 52,53,54,55) from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups). Emissions are calculated the same as in the Baseline Scenario, Section 7.2.6 with respect to any timber harvesting in the project scenario. The project will undertake low levels of management activities, maintenance, ecological enhancement, and/or risk mitigation. All calculations in support of this are within: Emissions_PRJ_Estimate (Dec '22) spreadsheet. See Appendices.

7.3.6 Project Scenario GHG Emissions Calculation Summary

The CBM-CFS3 and supporting spreadsheets were used in combination with the spatial forest inventory data to calculate and track annual changes in both the biomass ($\Delta C_{PRJ,LB,t}$) and dead organic matter pools ($\Delta C_{PRJ,DOM,t}$) for the project scenario. Changes in carbon storage in harvested wood products ($\Delta C_{PRJ,HWP,t}$) and fossil fuel emissions ($\Delta_{PRJ,EMITFOSSIL,t}$) and summarized net carbon balances and buffer discounts were determined within the applicable spreadsheets.

The total annual carbon balance in year, t, for the project scenario ($\Delta C_{PRJ,t}$, in t C yr^{-1}) was calculated as:

$\Delta C_{PRJ,t} = \Delta C_{PRJ,P,t}$ (Equation 29)

where:

$\Delta C_{PRJ,P,t}$ is the annual change in carbon stocks in all pools in the baseline across the project activity area; t C yr^{-1}.

The annual change in carbon stocks in all pools in the project scenario across the project activity area ($\Delta C_{PRJ,P,t}$; t C yr^{-1}) was calculated as:

$\Delta C_{PRJ,P,t} = \Delta C_{PRJ,LB,t} + \Delta C_{PRJ,DOM,t} + \Delta C_{PRJ,HWP,t}$ (Equation 30)

where:

$\Delta C_{PRJ,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr^{1}

$\Delta C_{PRJ,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr^{-1}

$\Delta C_{PRJ,HWP,t}$ is the annual change in carbon stocks associated with harvested wood products, t C yr^{1}.

The annual change in carbon stocks in living tree biomass (above- and belowground) in the project scenario ($\Delta C_{PRJ,LB,t}$; t C yr^{-1}) was calculated as:

$\Delta C_{PRJ,LB,t} = \Delta C_{PRJ,G,t} - \Delta C_{PRJ,L,t}$ (Equation 31)

where:

$\Delta C_{PRJ,G,t}$ = annual increase in tree carbon stock from growth; t C yr^{-1}

$\Delta C_{PRJ,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr^{-1}.

The annual change in carbon stocks in dead organic matter (DOM) ($\Delta C_{PRJ,DOM}$; t C yr^{-1}) in the project scenario was calculated as:

$\Delta C_{PRJ,DOM,t} = \Delta C_{PRJ,LDW,t} + \Delta C_{PRJ,SNAG,t} + \Delta C_{PRJ,DBG,t}$ (Equation 38)

where:

$\Delta C_{PRJ,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr^{-1}

$\Delta C_{PRJ,SNAG,t}$ = change in snag carbon stock in year, t; t C yr^{-1}

$\Delta C_{PRJ,DBG,t}$ = change in below-ground carbon stock in year, t; t C yr^{-1}.

The annual change in the carbon stored in harvested wood products (HWP), ($\Delta C_{PRJ,HWP,t}$; t C yr^{-1}) in the project scenario was calculated as:

$\Delta C_{PRJ,HWP,t} = \Delta C_{PRJ,STORHWP,t} - \Delta C_{PRJ,EMITFOSSIL,t,}$ (Equation 46)

7.4 Leakage

7.4.1 Activity Shifting Leakage

As per the mentioned procedures in Section 5.3.1 above, it has been determined that no activity shifting leakage occurred within the verification period of 01-January 2018 to 31-December 2022.

The analysis of activity shifting leakage for the monitoring period was completed by comparing the variance between annual harvest objectives from the forest management plans to the cumulative actual harvest volumes of the same years on all forest lands owned and operated by Westphalen (7,076 ha) at the project start date. Within the 10-year forest management plan schedule (2015-2025), the allowable amount of harvest removal must not exceed the activity shifting threshold volume amount or activity shifting would be considered as occurring.

For the purposes of this analysis, it should be noted that yearly harvesting volume objectives from the forest management plans do not need to be adhered to on a yearly basis. During the years between 2018 to 2022 there was an unusually high amount of timber volume extracted due to calamity affected areas (particularly Spruce Beetle infestation throughout all of Germany). At the project start date through to 2021, Westphalen performed sanitary harvesting operations on calamity affected areas and a total of 288,273 m3 in damaged timber was removed from their properties. As this volume removal is considered regulatory and outside of the FMP parameters, it was not included in this evaluation.

Under the Forest Conservation and Forestry Promotion Act (Federal Forest Act), private landowners are legally obligated to sanitary harvest damaged timber related to calamities to ensure sustainable forests for future use. Prior to initiating harvest operations in such areas, landowners are required to contact the forest tax authorities for harvest approval, and at the years end, submit tax documents detailing logged volumes removed in accordance with the Forest Compensation Act and Section 34b of the Income Tax Act[17] (EstG).

The figure below demonstrates that the cumulative harvest volumes (dark blue bars) are both below the activity shifting threshold (red line), demonstrating that no activity shifting leakage is occurring.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

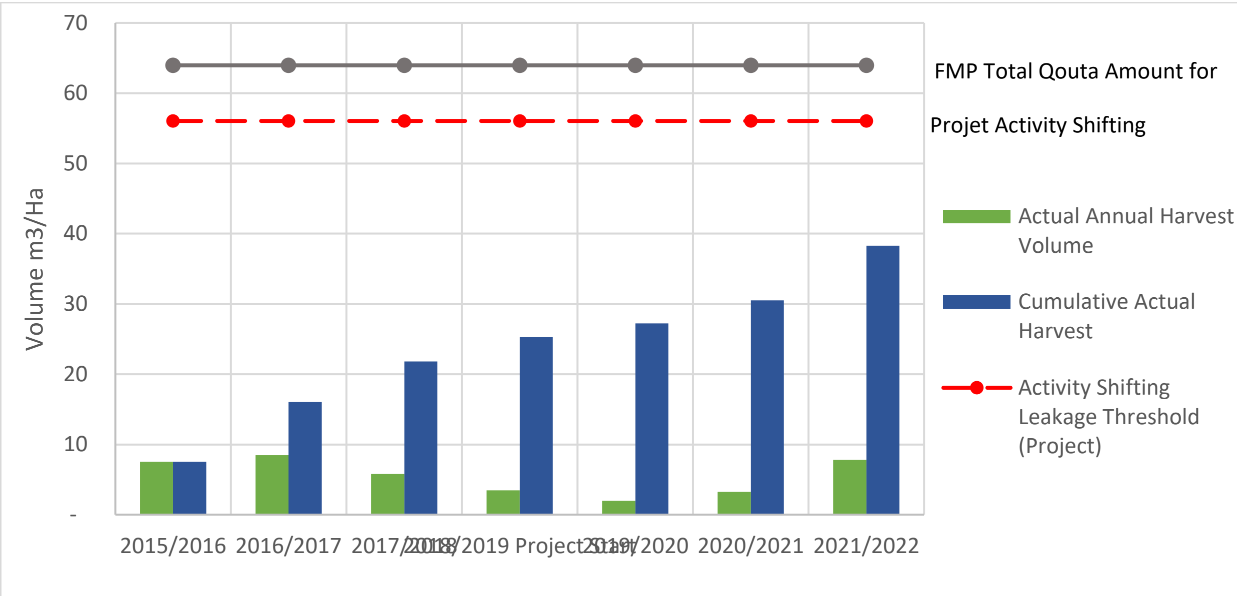

Figure 13: Comparison of harvest volumes during the monitoring period (all values in m³).

7.4.2 Market Shifting Leakage

The market leakage assessment described within Section 5.3.2 was completed for the verification period. The resulting market leakage factor (MLF_y) of 20% is applied within the net GHG Emission Reductions and Removals calculations.

7.5 Net GHG Emission Reductions and Removals

7.5.1 Calculation of the Uncertainty Factor

As per the methodology monitoring section specification, the project has installed at least one field plot in each Analysis Unit. The project has installed 31 permanent carbon plots in 2022.

The project-level uncertainty factor is calculated by a function within the Westphalen Uncertainty Calculator excel spreadsheet, following the formulas below:

[17] For more information on Tax rates for income from extraordinary wood uses, see weblink: § 34b EStG - individual standard (www-gesetze--im--internet-de.translate.goog)

Step 1 – the project calculated the average percent model error (E_M) for the project based on the average area-weighted difference between measured values in monitored plot observations and model-predicted values using Equations 60a, b.

$$E_M = 100 \bullet (\sum y_{d,h,i} / \sum(A_{PRJ,h} \bullet y_{m,h,i})) \qquad (60a)$$

where:

The summation is across all plot observations, i, and across all analysis units, h;

$$y_{d,h,i} = A_{PRJ,h} \bullet (y_{p,h,I} - y_{m,h,i}) \qquad (60b)$$

E_M = Mean model error for the project (%)

$y_{d,h,i}$ = the area-weighted difference between measured and predicted carbon storage in analysis unit, h, plot observation, i (t C)

$y_{m,h,i}$ = carbon storage measured in analysis unit, h, plot observation, i (t C ac^{-1})

$y_{p,h,i}$ = carbon storage predicted by model for analysis unit , h, plot observation, i (t C ac^{-1}) $A_{PRJ,h}$ = area of project analysis unit, h (ac)

Step 2 – The project calculated the inventory error (E_I) at a 90 percent confidence interval expressed as a percentage of the mean area-weighted inventory estimate from the measured plots. Inventory error is estimated based upon the difference between modeled and measured values for monitoring plots established in polygons grouped within analysis units.

Inventory error, E_I, is estimated by first calculating the standard error of the area-weighted differences between the plot observation measurement and the associated model-predicted carbon storage (both on a per hectare basis) for analysis units. The standard error is then multiplied by the *t*- value for the 90 percent confidence interval. Finally, E_I is expressed in relative terms (in Equation 60c) by dividing the 90% confidence interval of the area-weighted differences between predicted and measured values in all plots by the area-weighted average of the measured values in all monitoring plots.

$$E_I = 100 \bullet [SE * 1.654 / ((1/N) \bullet \sum(A_{PRJ,h} \bullet y_{m,h,i}))] \qquad (60c)$$

where:

E_I = Inventory error for the project (%)

SE = the project level standard error of the area weighted differences between measured plot observation and predicted values of carbon storage.

N = total number of plot observations in all analysis units 1.654 = the 90% confidence interval t-value

All other terms as defined in equation 60a.

$$SE = S/ \sqrt{N} \qquad (60d)$$

where:

N = total number of plot observations in all analysis units

S = the standard deviation of the area weighted differences between measured and predicted values of carbon storage across all analysis units.

$S = \sqrt{[(1/N-1) \cdot \sum(y_{d,h,i} - \bar{y}bar_d)^2]}$ (60e)

where:

$ybar_d$ = the project-level mean of the area weighted differences between measured plot observation and predicted values of carbon storage. See equation 60b for the calculation of $y_{d,h,i}$

All other terms as defined in equation 60b and 60c.

Step 3 - The total error for the project (E_P; %) is calculated by adding the model and inventory error terms, as calculated in Steps 1 and 2.

$E_P = E_M + E_I$ (60f)

Step 4 – Compare the result of Step 3 against the table below to determine the uncertainty factor.

Table 22: Uncertainty Factor calculation

Estimated Project Error, E_P (%)	Uncertainty Factor (= $ER_{Y,ERR}$)
0 – 10%	= 1.5%
>10%	= 1.5% + EP – 10%

7.5.2 Initial Estimate of Uncertainty

Carbon plot volumes were compiled using CBM-CFS3. The inventory error term (E_I) was calculated to be 0.21% while the model error term (E_M) was -0.26%. As shown in Equation 60f, the project error term (E_P) was calculated as the sum of E_M and E_I (-0.05 %). Thus, the uncertainty factor ($ER_{Y,ERR}$) was calculated to be 1.5%.

This uncertainty factor will be re-assessed at verification and adjusted annually to reflect improved field data from the project monitoring plot network.

7.5.3 Calculation Net Emissions Reductions

Net carbon emissions reductions (ER_y) created by the Westphalen Forest Carbon Project were calculated annually utilizing equation 58:

$ER_y = ER_{y,GROSS} - LE_y$ (58)

where:

ER_y = the net GHG emissions reductions and/or removals in year y (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) (t CO_2e yr^{-1}).

$ER_{y,GROSS}$ =the difference in the overall annual carbon change between the baseline and project scenarios (t CO_2e yr^{-1}), as calculated within Section 7.5.3.

LE_y = Leakage in year y (t CO_2e yr^{-1}), as described in Section 5.3.

7.5.4 Calculation of Voluntary Credit Units (VCUs)

The number of VCU's the Westphalen Forest Carbon Project generates as available for issuance and sale in year, *y* (VCU_y; t CO_2e yr^{-1}), is calculated as:

$$VCU_y = ER_y \bullet (1 - ER_{y,ERR}) - BR_y \qquad (59)$$

where:

ER_y = the net GHG emissions reductions and/or removals in year (t CO_2e yr^{-1}), as calculated in equation 58.

$ER_{y,ERR}$ = the uncertainty factor for year, y, (calculated in Section 7.5.3), expressed as a proportion.

BR_y = estimated VCU-equivalent tCO_2e issued to the VCS Buffer Pool in year, *y*, calculated using the latest version of the VCS Tool for AFOLU Non-Permanence Risk Analysis and Buffer (Voluntary Carbon Standard, 2008).

BRy is calculated by multiplying the most current verified permanence risk Buffer Withholding Percentage for the project by the change in carbon stocks (difference between baseline and project scenario) for the project area.

The project VCS Buffer Discount Factor (BR_Y) was calculated as 14%, as per the non-permanence risk assessment. The BR factor will be re-assessed at each verification, as necessary.

The uncertainty factor was determined to be 1.5%, as calculated above. The uncertainty factor will be re-calculated from field plot data at each verification.

The annual VCUs projected for Westphalen for the verification period of 01-January-2018 to 31-December-2021 are calculated in Table 23

Table 23: Net GHG Emissions Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for Issuance
01-Jan-2018 – 31-December-2018	-4,058	-978	616	2,464	345	2,082
01-Jan-2019 - 31-December-2019	-4,255	-4,000	51	204	29	173
01-Jan-2020 - 31-December-2020	-4,555	-1,909	529	2,117	296	1,789
01-Jan-2021 - 31-December-2021	-4,770	5,363	2,027	8,106	1,135	6,850
Total	**-17,638**	**-1,524**	**3,223**	**12,891**	**1,805**	**10,893**

Resulting values may be found in the Appendix.

Table 24: Monitoring Period Estimated and Achieved Emission Reductions and Removals

Year	Ex-ante emissions reductions/removals	Achieved emissions reductions/removals	Percent difference	Justification for the difference
01-Jan-2018 – 31-December-2018	2,464	2,464	0	As this is a validation and verification there is no difference in the Ex-Ante and Ex-Post estimates.
01-Jan-2019 - 31-December-2019	204	204	0	As this is a validation and verification there is no difference in the Ex-Ante and Ex-Post estimates.
01-Jan-2020 - 31-December-2020	2,117	2,117	0	As this is a validation and verification there is no difference in the Ex-Ante and Ex-Post estimates.
01-Jan-2021 - 31-December-2021	8,106	8,106	0	As this is a validation and verification there is no difference in the Ex-Ante and Ex-Post estimates.

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APPENDIX 1 – NON-PERMANENCE RISK REPORT

WESTPHALEN FOREST CARBON PROJECT NON-PERMANENCE RISK REPORT

Document Prepared by Zimmfor Management Services Ltd.

Project Title	Westphalen Forest Carbon Project
Version	1.2
Date of Issue	12-February-2024
Project ID	3363
Monitoring Period	01-January -2018 to 31-December 2021
Prepared By	Zimmfor Management Services Ltd.
Contact	2218-D Airport Drive, Campbell River, BC, V9H 0E2, Canada Tel: +1 604 619 1585 Email: info@zimmfor.com Website: www.zimmfor.com

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1 INTERNAL RISK

1.1 Project Management

a) Westphalen utilizes 100% native species in reforestation using locally sourced seed stock and following typical forest regeneration practices in Germany. Multiple species maybe planted in a manner consistent with local forest types.

b) The project area has controlled access with locked gates on road access points. Several reports state[1] the absence of illegal harvesting within Germany, and therefore additional enforcement is not deemed necessary.

c) The management team has extensive experience in forest management including, certification systems, audits and inspections, due diligence and legality, and project management. The team is comprised of Registered Professional Foresters (RPFs), Professional Engineers (P.Eng), Registered Professional Biologists (RPBio), and other resource professionals. Westphalen project lands are currently managed by a German Professional Forester and is specifically under the direction of the owner and resource manager.

d) The management team resides within the country. The most widespread project instances located in Kiel are within a day's travel from the corporate office based in Meschede.

e) The management team does not specifically include members with significant experience in AFOLU project design and implementation, however, is working directly with Implementation Partner and Project Developer, Zimmfor Management Services Ltd. who have successfully managed projects through validation, verification, and issuance of GHG credits.

f) The property management plan is a detailed and dynamic program that is updated on a regular basis to incorporate monitoring and other new information as it is collected. Westphalen has implemented an active management plan in the form of annual Management Reviews to review and discuss the project and results of monitoring, as well as analyze any needs for plan adaptation and create corrective/ preventative actions. The following will be reviewed during management reviews: Past meeting minutes & outstanding tasks, issues, concern and or complaints raised, updates to legislation, research, technology and certification standards, project management updates, monitoring results, status of action plans, non-permanence report, audit schedule/plans, training plans and activities & operations (refer to Zimmfor Management Review Checklist and Corrective Action Log).

1.2 Financial Viability

c) The project cashflow breakeven point is currently projected at 4-7 years from the current risk assessment.

h) The project has secured 80% of funding needed to cover the total cash out before the project reaches is breakeven point.

i) The project has available as callable financial resources at least 50% of the total cash out before the project reaches breakeven.

[1] Forest Stewardship Certification (FSC). FSC-NRA-DE V1-1, National Risk Assessment for Germany 2020. https://connect.fsc.org/document-centre/documents/resource/201

1.3 Opportunity Cost

e) The NPV from the most profitable alternative land use activity is expected to be between 20-50% more than from project activities. An IRR under carbon scenarios is difficult to assess due to the high variability of voluntary carbon prices. An initial assessment of the project scenario under similar carbon pricing scenarios found on the American Carbon Registry was used to determine a price of approximately $21.70 USD (±20%).

h) The Westphalen Forest Carbon Project is not protected by a legally binding commitment to continue management practices that protect the credited carbon stocks over the length of the project crediting period or 100 years.

1.4 Project Longevity

a) Westphalen is without legal agreement or requirement via conservation easement or protected area to continue the management practice (i.e., avoid emissions for the entire project longevity). The project period is for a 30-year duration.

2 EXTERNAL RISK

2.1 Land Tenure and Resource Access Impacts

a) The entire project area and the resources encompassed within are owned by Matthias Graf von Westphalen. Refer to the Project Description Document for an example of land ownership evidence.

c) There are no title disputes or other ownership disputes on the Westphalen property.

d) There are no access or use right disputes.

e) The project is not defined as a Wetlands Restoration and Conservation (WRC) project category.

2.2 Community Engagement

a) There are no communities living directly within the project area instances (private land) that are reliant on the project lands for essential food, fuel, fodder, medicines or building materials.

b) There are no communities living within 20 km of the project area that are reliant on the project lands for essential food, fuel, fodder, medicines or building materials.

As the local populations are not reliant on the project area the risk is not relevant to the project and the risk rating for community engagement (CE) shall be zero. Community engagement was conducted prior to project validation (refer to Local Stakeholder Consultation, Section 2.2 of the joint Project Description and Monitoring Report) and no comments were received relating to project design.

2.3 Political Risk

e) The governance score for Germany on a 5-year average is 1.47.

Table 1 World Bank Governance Indicators for Germany 2016 - 2020 (Source: http://info.worldbank.org/governance/wgi/Home/Reports)

World Bank Governance Indicators - Germany 2016-2020				
Indicator	Country	Year	Governance (-2.5 to +2.5)	5-year average
Voice and Accountability	Germany	2016	1.36	
		2017	1.43	
		2018	1.43	
		2019	1.36	
		2020	1.38	1.39
Political Stability and Absence of Violence/Terrorism	Germany	2016	0.68	
		2017	0.59	
		2018	0.59	
		2019	0.57	
		2020	0.67	0.62
Government Effectiveness	Germany	2016	1.70	
		2017	1.65	
		2018	1.56	
		2019	1.53	
		2020	1.36	1.56
Regulatory Quality	Germany	2016	1.82	
		2017	1.79	
		2018	1.76	
		2019	1.72	
		2020	1.58	1.73
Rule of Law	Germany	2016	1.62	
		2017	1.61	
		2018	1.63	
		2019	1.62	
		2020	1.56	1.61
Control of Corruption	Germany	2016	1.83	
		2017	1.84	
		2018	1.94	
		2019	1.90	
		2020	1.86	1.87
Overall Average Score				1.47

f) Germany has established FSC and PEFC standards bodies.

3 NATURAL RISK

3.1 Significance

In the recent past, Germany has experienced significant forest damage due to the effects of climate change; most specifically drought, leading to increased forest fires, increased pest and disease outbreak, and increased forest mortality. This issue has been recognized by the German government, and in 2019, the largest aid package for German forestry to date was made, committing 800 million Euros from 2020 – 2023[2] for private and municipal forest owners to deal with forest damage and improve forest adaptation to prepare for climate change.

For the purpose of this non-permanence risk report and as stated in Section 1.12 of the PD a single geographic area is specified as natural risks discussed below are similar throughout the 9 administrative regions and the 8 forest ecosystem types

a) Fire

On a multi-year average, around 300 hectares of forest are damaged by forest fires in Germany every year, albeit with a clear regional focus. The states of Brandenburg, Berlin, Saxony, Saxony-Anhalt and Lower Saxony are most affected (outside of carbon area). Thanks to extensive prevention and countermeasures, forest fires in Germany can usually be contained on a small scale (average damage area 0.4 hectares)[3].

Rating: Insignificant (less than 5% loss of carbon stocks)

b) Pest and Disease Outbreaks

Spruce Bark Beetle Infestations are high in spruce trees and have been exacerbated by drought in recent years. Copper Worm has also been identified as affecting the spruce stock. The regional focal points of the damage are primarily in Hesse, North Rhine-Westphalia (minor project area instances are located here), Rhineland-Palatinate, Lower Saxony, Thuringia, Saxony and Saxony-Anhalt. As of 2021, 16 percent of the spruce stock identified nationwide in the 2012 federal forest inventory has died due to pest infestations[2].

On all Westphalen owned properties, within the last 5 years, 45% of the total forest stock was harvested due to "calamities" such as beetle kill, and copper worm. The majority of the harvest due to insect calamity occurred in the 2018/2019 and 2019/2020 fiscal years with 16% and 18% of the harvest, respectively. Excluding these outlier years, the average loss due to insects is 4% a year.

During project design very few spruce stands were allocated to the Project Activity Instances (PAI) and is reflected in Table 18 of the project document where a description of forest analysis

[2] https://www.bmel.de/DE/themen/wald/wald-in-deutschland/wald-trockenheit-klimawandel.html;jsessionid=DC14C3FCC7A1F6DF5A0381B025E88501.internet2842#doc14830bodyText4

[3] Forest Report of the Federal Government (2017)

units is provided. Spruce stands account for 3.6% of the PAI by area. Additionally, where spruce was selected they are not below an elevation of 500m due to bark beetle infestations.

Rating: Minor (5% to less than 25% loss of carbon stocks)

c) Extreme Weather

Recently a record 3-year drought from 2018 – 2020 killed more than 2.5% of Germany's forests[4]. This was the worst drought ever recorded in Germany. At present, as a result of drought and related beetle infestations in the period 2018 through mid 2020, timber damage across Germany is estimated to have reached about 178 million m^3 (BMEL, 2020). Although drought has historically been a significant threat to forests in Germany, due to the challenges related to climate change, it is anticipated that more frequent drought events will occur.

Historically, storm events that have also been the cause of a large forest destruction. In 1990, Germany was hit by a series of hurricanes that damaged about 70 million m^3 of timber. In 2007, hurricane "Kyrill" struck, leaving behind about 37 million m^3 of damaged timber.

On all Westphalen owned properties, within the last 5 years, 25% (majority (11%) of the loss resulting in the 2018/2019 fiscal year to due drought) of the total forest stock was harvested due to windthrow. Excluding the outlier year, the average loss due to windthrow is 3.5% annually.

Rating: Insignificant (less than 5% loss of carbon stocks)

d) Geological Risk

Westphalen is not subject to any nearby geological risks from earthquake, volcano, etc. The most seismically active zone within Germany is the Lower Rhine Graben zone, and strong earthquakes (5.5 – 6.0) are known to occur approximately every 200 years[5].

An earthquake occurring on April 13, 1992 is considered the most destructive earthquake in modern history of Germany due to damage experienced in urban centers. No records were found to attribute damage to the project area as a result of this earthquake.

Other geological risks associated with the Westphalen forests are landslides. To date, no significant erosion or loss of forested area (greater than 4 ha) has been attributed to landslide activity.

Rating: No loss

e) Other Natural Risk

[4] https://www.science.org/content/article/germany-s-trees-are-dying-fierce-debate-has-broken-out-over-how-respond

[5] https://www.gfz-potsdam.de/en/section/seismic-hazard-and-risk-dynamics/topics/where-in-germany-does-the-earth-quake/seismicity-in-germany-in-global-context

The Westphalen properties are subject to minor animal browse, especially on younger stands. Although this is seen as a nuisance, mitigation measures in place have been effective and have prevented any significant loss of stands. This risk also dominantly pertains to juvenile stands.

Rating: No loss

3.2 Likelihood

f) Fire

Germany has a naturally occurring annual fire season that usually begins in late March and ends by the beginning of October. Data from the last 10 years of fire seasons within Germany show an average of 60 VIIRS Alert[6] fire alerts per season.

Rating: Less than every 10 years.

g) Pest and Disease Outbreaks

Although pine beetles have always been present within German forests, the most recent outbreak event commenced with a severe winter storm in 2018 followed by an extended drought. The current outbreak is being noted as a “catastrophe of the century”[7] for German forests, as for many, the level of destruction due to beetle infestation has not been experienced in their lifetime. Although pest outbreaks at the current level have not historically been a significant threat to forests in Germany, due to the challenges related to climate change, it is anticipated that more frequent pest infestation events could occur.

Rating: Every 50 to less than 100 years.

h) Extreme Weather

Recently a record 3-year drought from 2018 – 2020 killed more than 2.5% of Germany’s forests[8]. This was the worst drought ever recorded in Germany. At present, as a result of drought and related beetle infestations in the period 2018 through mid-2020, timber damage across Germany is estimated to have reached about 178 million m^3 (BMEL, 2020).

Historic storm events that have damaged very large numbers of trees in Germany have occurred in the past. In 1990, Germany was hit by a series of hurricanes that damaged about 70 million m^3 of timber. In 2007, hurricane "Kyrill" struck, leaving behind about 37 million m^3 of damaged timber, and with the most recent droughts in 2018 – 2020, the likelihood of extreme weather is becoming more common.

Rating: Less than every 10 years.

i) Geological Risk

[6] Visible Infrared Imaging Radiometer Suite (VIIRS) Alert fire alerts represent a 375m pixel thermal anomaly as detected by NASA satellites. https://www.earthdata.nasa.gov/learn/find-data/near-real-time/firms/viirs-i-band-375-m-active-fire-data

[7] https://phys.org/news/2019-09-germany-climate-stressed-trees-catastrophe-bugs.html

[8] https://www.science.org/content/article/germany-s-trees-are-dying-fierce-debate-has-broken-out-over-how-respond

As previously stated, larger geological events within Germany are known to occur approximately every 200 years.

Rating: Once every 100 year or more, or risk is not applicable to project area

j) Other Risk

Since animal browse, specifically by ungulates, predominantly effects juvenile stands, the likelihood of this risk follows the cutting and planting cycle of the forested lands.

Rating: Every 10 years to less than 25 years

3.3 Score (LS)

The Score is assigned through a matrix based on significance and likelihood.

a) Fire (F) = 2

b) Pest and Disease Outbreaks (PD) = 1

c) Extreme Weather (W) = 2

d) Geological Risk (G) = 0

e) Other Natural Risk = 0

3.3.1 Mitigation

a) Fire

Within Germany, forest officers monitor the forest lands (private and public) for fire activity. If a property is at a higher risk of forest fire, property owners can alert the forest officers and the property will be monitored more extensively. Additionally, Westphalen implements their own fire mitigation plan that includes periodic fire fighter training for staff and fire fighting tools and water tanker availability during fire season to allow for immediate response in the event of a fire.

Rating multiplier: Prevention measures applicable to the risk factor are implemented and project proponent has proven history of effectively containing natural risk = 0.25

*Total Rating = 2 * 0.25 = 0.5*

b) Pest and Disease Outbreaks

To protect the forest area from pests and disease outbreak field monitoring is completed by forestry personnel. Preventative measures include maintaining natural densities, timely removal of harvested fiber, reforestation using native species (non-monoculture) and hygienic cutting.

Rating multiplier: Prevention measures applicable to the risk factor are implemented = 0.5

*Total Rating = 1 * 0.5 = 0.5*

c) Extreme Weather

To protect forests from extreme wind events, pre-commercial thinning is completed on stands that are 3m tall or higher for all species, with follow up treatments to prevent the trees from exceeding 28m in height, therefore protecting them from breakage due to wind. In some areas, hardy species are planted on the windward side of the stands to act as a wind break.

To protect beech stands from sun damage, protective stand management measures such as wrapping the trunks in burlap are implemented.

Rating multiplier: Prevention measures applicable to the risk factor are implemented and project proponent has proven history of effectively containing natural risk = 0.25

*Total Rating = 2 * 0.25 = 0.5*

d) Geological Risk

There is no mitigation in place for geological risks,

Rating multiplier: None of the above = 1.0

*Total Rating = 0 * 1.0 = 0*

e) Other Risk

To offset and possible risk due to animal browse, Westphalen leases 40% of their forest lands for the purposes of exclusive hunting rights. On the remaining 60% of the property, both Westphalen staff and the public are permitted to hunt.

Fencing is also used to keep fallow deer out of higher risk areas.

Rating multiplier: Prevention measures applicable to the risk factor are implemented and project proponent has proven history of effectively containing natural risk = 0.25

*Total Rating = 0 * 0.25 = 0*

STEP 1: RISK ANALYSIS

1 INTERNAL RISK

Project Management		
a)	Species planted (where applicable) associated with more than 25% of the stocks on which GHG credits have previously been issued are not native or proven to be adapted to the same or similar agro-ecological zone(s) in which the project is located.	0
b)	Ongoing enforcement to prevent encroachment by outside actors is required to protect more than 50% of stocks on which GHG credits have previously been issued.	0
c)	Management team does not include individuals with significant experience in all skills necessary to successfully undertake all project activities (ie, any area of required experience is not covered by at least one individual with at least 5 years experience in the area).	0
d)	Management team does not maintain a presence in the country or is located more than a day of travel from the project site, considering all parcels or polygons in the project area.	0
e)	**Mitigation:** Management team includes individuals with significant experience Management team includes individuals with significant experience in AFOLU project design and implementation, carbon accounting and reporting (eg, individuals who have successfully managed projects through validation, verification and issuance of GHG credits) under the VCS Program or other approved GHG programs.	-2
f)	**Mitigation:** Adaptive management plan in place	-2
Total Project Management [a + b + c + d + e + f]		-4
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		

Financial Viability		
Q	How many years does it take for the cumulative cashflow to break even?	b)
Q	What percentage of funding is needed to cover the total cash out before the project breaks even has been secured?	h)
a)	Project cash flow breakeven point is greater than 10 years from the current risk assessment	0
b)	Project cash flow breakeven point is between 7 and up to less than 10 years from the current risk assessment	2
c)	Project cash flow breakeven point between 4 and up to less than 7 years from the current risk assessment	0
d)	Project cash flow breakeven point is less than 4 years from the current risk assessment	0
e)	Project has secured less than 15% of funding needed to cover the total cash out before the project reaches breakeven	0
f)	Project has secured 15% to less than 40% of funding needed to cover the total cash out required before the project reaches breakeven	0
g)	Project has secured 40% to less than 80% of funding needed to cover the total cash out required before the project reaches breakeven	0
h)	Project has secured 80% or more of funding needed to cover the total cash out before the project reaches breakeven	0
i)	**Mitigation:** Project has available as callable financial resources at least 50% of total cash out before project reaches breakeven	-2
Total Financial Viability [(a, b, c or d) + (e, f, g or h) + i]		0
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		

Opportunity Cost		
Q	What is the NPV from the most profitable alternative land use activity compared to NPV of project activity?	e)
a)	NPV from the most profitable alternative land use activity is expected to be at least 100% more than that associated with project activities; or where baseline activities are subsistence-driven, net positive community impacts are not demonstrated	0
b)	NPV from the most profitable alternative land use activity is expected to be between 50% and up to100% more than from project activities	0
c)	NPV from the most profitable alternative land use activity is expected to be between 20% and up to 50% more than from project activities	0
d)	NPV from the most profitable alternative land use activity is expected to be between 20% more than and up to 20% less than from project activities; or where baseline activities are subsistence-driven, net positive community impacts are demonstrated	0
e)	NPV from project activities is expected to be between 20% and up to 50% more profitable than the most profitable alternative land use activity	-2
f)	NPV from project activities is expected to be at least 50% more profitable than the most profitable alternative land use activity	0
g)	**Mitigation:** Project proponent is a non-profit organization	0
h)	**Mitigation:** Project is protected by legally binding commitment to continue management practices that protect the credited carbon stocks over the length of the project crediting period (see project longevity)	0
i)	**Mitigation:** Project is protected by legally binding commitment to continue management practices that protect the credited carbon stocks over at least 100 years (see project longevity)	0
Total Opportunity Cost [(a, b, c, d, e or f) + (g + h or i)]		-2
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may be less than zero		

Project Longevity		
Q	Does the project have a legally binding agreement that covers at least a 100 year period from the project start date?	No
Q	What is the project Longevity in years?	30
Q	Legal Agreement or requirement to continue management practice?	No
a)	Without legal agreement or requirement to continue the management practice	18
b)	With legal agreement or requirement to continue the management practice	0
Total Project Longevity		18
Note: Total may not be less than zero. Any project with a legally binding agreement that covers at least a 100 year period from the project start date will be assigned a score of zero. Any project with a project longevity of less than 30 years fails the risk assessment		

Total Internal Risk (PM + FV + OC + PL)	**12**
Note: Total may not be less than zero	

2 EXTERNAL RISK

Q	Are the ownership and resource access/use rights held by the same of different entities?	Same
a)	Ownership and resource access/use rights are held by same entity(s)	0
b)	Ownership and resource access/use rights are held by different entity(s) (eg, land is government owned and the project proponent holds a lease or concession)	0
c)	In more than 5% of the project area, there exist disputes over land tenure or ownership	0
d)	There exist disputes over access/use rights (or overlapping rights)	0
e)	WRC projects unable to demonstrate that potential upstream and sea impacts that could undermine issued credits in the next 10 years are irrelevant or expected to be insignificant, or that there is a plan in place for effectively mitigating such impacts	0
f)	**Mitigation:** Project area is protected by legally binding commitment (eg, a conservation easement or protected area) to continue management practices that protect carbon stocks over the length of the project crediting period	0
g)	**Mitigation:** Where disputes over land tenure, ownership or access/use rights exist, documented evidence is provided that projects have implemented activities to resolve the disputes or clarify overlapping claims	0
Total Land Tenure [(a or b) + c + d + e + f +g)]		**0**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may not be less than zero		

a)	Less than 50 percent of households living within the project area who are reliant on the project area, have been consulted	0
b)	Less than 20 percent of households living within 20 km of the project boundary outside the project area, and who are reliant on the project area, have been consulted	0
c)	**Mitigation:** The project generates net positive impacts on the social and economic well- being of the local communities who derive livelihoods from the project area	0
Total Community Engagement [a + b + c]		**0**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may be less than zero		

Q	What is the country's calculated Governance score?	1.47
a)	Governance score of less than -0.79	0
b)	Governance score of -0.79 to less than -0.32	0
c)	Governance score of -0.32 to less than 0.19	0
d)	Governance score of 0.19 to less than 0.82	0
e)	Governance score of 0.82 or higher	
f)	**Mitigation:** Country implementing REDD+ Readiness or other activities such as: a) The country is receiving REDD+ Readiness funding from the FCPF, UN-REDD or other bilateral or multilateral donors b) The country is participating in the CCBA/CARE REDD+ Social and Environmental Standards Initiative c) The jurisdiction in which the project is located is participating in the Governors' Climate and Forest Taskforce d) The country has an established national FSC or PEFC standards body e) The country has an established DNA under the CDM and has at least one registered CDM A/R project	-2
Total Political [(a, b, c, d or e) + f)]		**0**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may not be less than zero		

Total External Risk (LT + CE +PC)	**0**
Note: Total may not be less than zero	

3 NATURAL RISK

Risk Category Factors				Risk Rating
a)	Fire (F)	2	0.25	0.50
b)	Pest and Disease Outbreaks (PD)	1	0.50	0.50
c)	Extreme Weather (W)	2	0.25	0.50
d)	Geological Risk (G)	0	1.00	0.00
e)	Other natural risk (ON1)	0	0.25	0.00
f)	Other natural risk (ON2)			0.00
g)	Other natural risk (ON3)			0.00

Total Natural Risk [F + PD + W + G + ON]	1.50
Note: When a risk factor does not apply to the project, the score shall be zero for such factor	
Risk rating is determined by [LS x M]	

Total Natural Risk (F + PD + W + G + ON)	**1.50**
Note: Total may not be less than zero	
If the Total Natural Risk is above 35 then the project fails the entire risk	`

STEP 2: OVERALL NON-PERMANENCE RISK RATING AND BUFFER DETERMINATION

Risk Category		**Rating**
a)	Internal risk	12.00
b)	External risk	0.00
c)	Natural Risk	1.50
Overall risk rating (a + b + c)		**14**
Note: Overall risk rating shall be rounded up to the nearest whole percentage		
The minimum risk rating shall be 10, regardless of the risk rating calculated		
If the overall risk rating is over 60 then the project fails the entire risk analysis		
Total Risk Assessment		**14%**
Net change in the project's carbon stocks		12891
TOTAL NUMBER OF CREDITS TO BE DEPOSITED IN THE AFOLU POOLED BUFFER ACCOUNT		**1805**

APPENDIX 2 – OUTPUT FROM CBM-CFS3 MODEL RUNS

Time Step	Delta Total Ecosystem* (BSL)	Delta Total Ecosystem (PRJ)
0	-	-
1	-1,032	-231
2	-1,106	-96
3	-1,167	110
4	-1,229	-367
5	-1,297	634
6	-1,363	752
7	-1,403	856
8	-1,419	926
9	-1,402	631
10	-1,419	644
11	-1,401	667
12	-1,387	685
13	-1,380	692
14	-1,374	700
15	-1,404	704
16	-1,383	707
17	-1,367	705
18	-1,352	707
19	-1,273	707
20	-1,327	702
21	-1,299	685

22	-1,257	683
23	-1,243	671
24	-1,200	662
25	-1,299	628
26	-1,253	629
27	-1,469	620
28	-1,471	615
29	-1,425	618
30	-1,386	611

* - For analyses of Total Delta Ecosystem, annual values greater than zero indicate that the ecosystem is functioning as a carbon sink. Annual values below zero indicate that the ecosystem is functioning as a carbon source. An annual value of exactly zero indicates that the ecosystem is carbon-neutral (i.e., neither a source nor a sink).

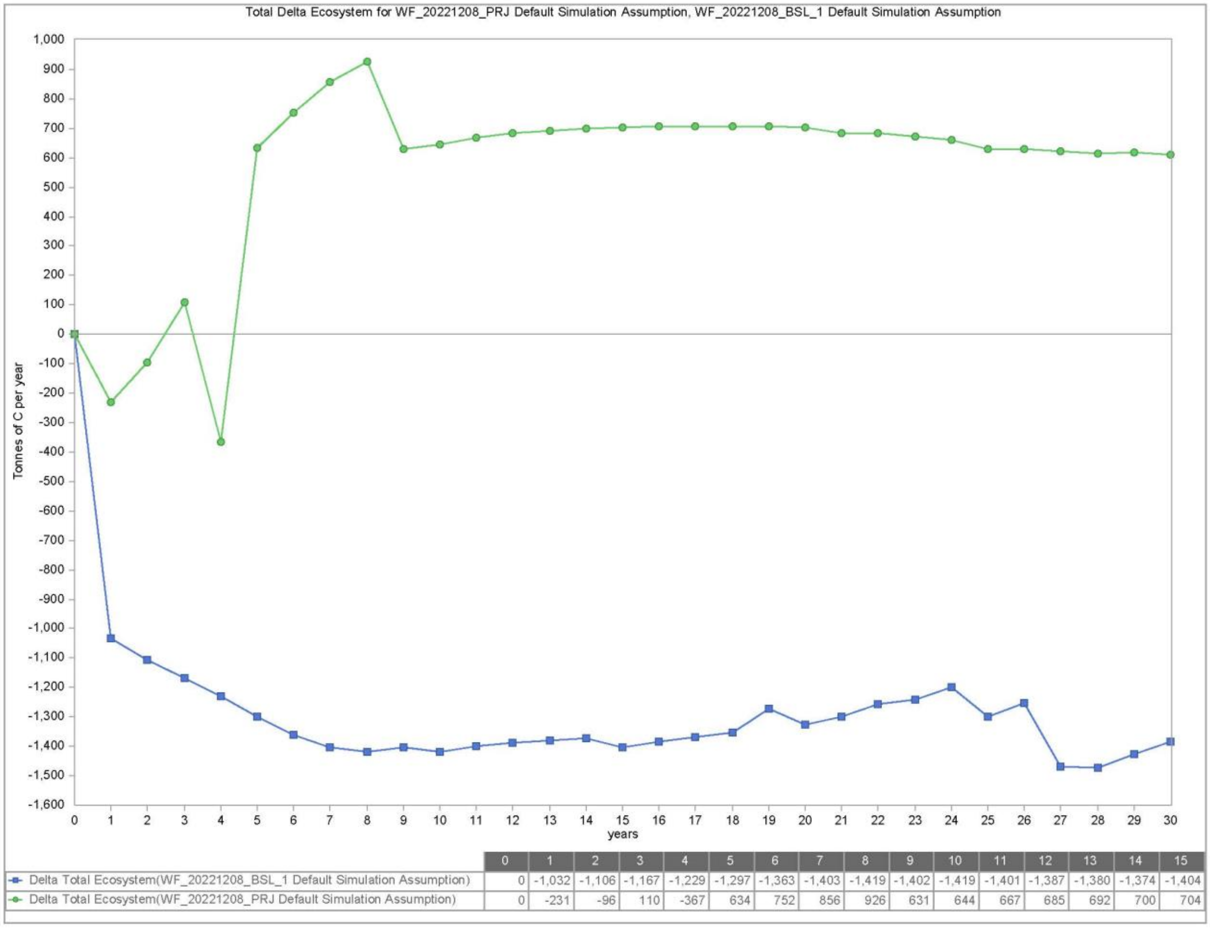

Figure 14: CBM-CFS graphical output of Total Delta Ecosystem between the baseline (blue) and Project (green) scenarios (tC).

APPENDIX 3 – SUPPORTING DATA FILES

The following table identifies the key data files used for calculating all aspects of the Project Development Document. All additional files not submitted here will be provided to the Auditors upon request.

Table 25: List of reporting document files used in the formation of the Westphalen Project Development Document

Description	Filename	Format	Date
Spatial Inventory data	WP_CarbonProjectArea_2022	KML	2022-12-02
Project inventory dataset	MonitorPlot_Inventory_Dec'22'	Excel	2022-12-09
CBM-CFS Stores result and run assumptions along with all carbon pools and fluxes related to the BSL model run	WF_20221208_BSL_1 Default Simulation Assumption	Access Datafile (large)	2022-12-08
CBM-CFS Stores result and run assumptions along with all carbon pools and fluxes related to the PRJ model run	WF_20221208_PRJ Default Simulation Assumption	Access Datafile (large)	2022-12-08
CBM-CFS Delta Ecosystem Results (BSL and PRJ)	Delta_Eco_Dec08’22xls	Excel	2022-12-08
CBM disturbances by Harvested Biomass (tC)	Harvest_Bio+Snags_Dec08’22	Excel	2022-12-08
Annual Change in HWP in the baseline/ project	Westphalen - BSL HWP (Dec '22) v5 Westphalen - PRJ HWP (Dec '22) v3	Excel Excel	2022-12-09 2022-12-09

Fossil Fuel emissions in the baseline/ project	Emissions_BSL_Estimate (Dec'22)v2 Emissions_PRJ_Estimate (Dec '22)	Excel Excel	2022-12-09 2022-12-09
Project GHG Estimate	Westphalen Final GHG Estimate (Feb'24)	Excel	2024-02-12
Calculation of Uncertainty Factor	Westphalen - Uncertainty Calculator (Dec '22)	Excel	2022-12-02
Monitoring plots – compiled merch volume	"Analysis Unit" Volume-Biomass Calculations	Excel	2022-10-05
Monitoring plots – compiled CWD volume	"Analysis Unit" Volume-Biomass Calculations	Excel	2022-10-05
Activity Shifting Leakage Analysis	Westphalen Activity Shifting Leakage (Dec'22)	Excel	2022-12-12
Market Leakage	MARketz Tool_Westphalen(Oct'23)v2.2	Excel	2023-10-12
Non-Permanence-Risk-Report	VCS-Non-Permanence-Risk-Report-Westphalen (Feb'24)	Word	2024-02-12
NPV Analysis	Westphalen - NPV Analysis for Non-Perm Risk Report - 2022-12-12	Excel	2022-19-12
VCS-Risk-Report	Westphalen - VCS-Risk-Report-Calculation-Tool-v4.0 (Feb'24)	Excel	2024-02-12

APPENDIX 4 – SPATIAL NDVI ANALYSIS

Monitoring – Project Area:

The spatial monitoring program was implemented to identify natural disturbance events >4ha, planned project activities such as harvests, road construction and reforestation, and unplanned anthropogenic ("human-caused") disturbances such as illegal or unplanned harvests, as well as any loss events[18].

Changes in vegetation cover were monitored by comparing temporally distinct satellite images and their respective derived Normalized Difference Vegetation Indices (NDVI). The resulting analysis calculates either an increases or decrease in vegetation cover which can be classified and symbolized according to the magnitude of change. Changes are measured at the pixel scale of the imagery (20m x 20m for *Sentinel-2 2LA* imagery).

Losses of at least 0.5ha in area (12 continuous pixels) where assigned a unique Polygon ID, then further examined to categorize the change/ or loss as cloud cover-water reflection, natural disturbance, planned project activities or unplanned harvests.

Data Acquisition:

To account for seasonality of vegetation cover, satellite imagery from 2020 and 2021 within a close seasonal range were selected for comparison analysis. Cloud cover was limited to between 0 and 3%, but not entirely avoidable due to the large project area coverage, the variability of timing for satellite flight paths, and days of data availability.

Data Classification:

Representative ranges were established for the change in NDVI over the designated time period.

Table 26: Classification Ranges for Changes in NDVI

NDVI change	Qualitative Classification
> 0.2	Significant vegetation gain
0.1 to 0.2	Vegetation gain
0.05 to 0.1	Minor vegetation gain
0 to 0.05	Minimal positive vegetation change
0 to -0.05	Minimal negative vegetation change
-0.05 to -0.1	Minor vegetation loss
-0.1 to -0.2	Vegetation loss
< -0.2	Significant vegetation loss

[18] Any event that results in a loss of more than 5 percent of previously verified emission reductions and removals due to losses in carbon stocks. See VCS Program Definitions v4.2.

Figure 15: Project Area Locations

Results/Conclusion:

The project area is non-contiguous and the PAI is located throughout Germany in the states of Schleswig-Holstein, Thuringia, North Rhine-Westphalia, and Lower Saxony.

No natural, planned, unplanned or loss disturbance events resulting in vegetation losses >0.5 ha were observed in the project for years 2021-2022. The completion of the NDVI spatial assessment between the years 2018 and 2021 indicates that no additional changes/ updates are required for analysis units utilized in calculating carbon stocks.

APPENDIX 5 – VM0012 EQUATIONS

Methodology Section #	Equation #	Screenshot
8.1.2	1	The total annual carbon balance in year, t, for the baseline scenario is calculated as ($\Delta C_{BSL,t}$, in t C yr^{-1}): $\Delta \mathbf{C_{BSL,t}} = \Delta \mathbf{C_{BSL,P,t}}$ **(1)** where: $\Delta C_{BSL,P,t}$ = annual change in carbon stocks in all pools in the baseline across the project activity area; t C yr^{-1} .
8.1.2	2	$\Delta \mathbf{C_{BSL,P,t}} = \Delta \mathbf{C_{BSL,LB,t}} + \Delta \mathbf{C_{BSL,DOM,t}} + \Delta \mathbf{C_{BSI,HWP,t}}$ **(2)** where: $\Delta C_{BSL,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr^{-1} $\Delta C_{BSL,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr^{-1} $\Delta C_{BSI,HWP,t}$ = annual change in carbon stocks associated with harvested wood products, t C yr^{-1}.
8.1.2	3	$\Delta \mathbf{C_{BSL,LB,t}} = \Delta \mathbf{C_{BSL,G,t}} - \Delta \mathbf{C_{BSL,i,t}}$ **(3)** where: $\Delta C_{BSL,G,t}$ = annual increase in tree carbon stock from growth; t C yr^{-1} $\Delta C_{BSL,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr^{-1}. *If the project area has been stratified, carbon pools are calculated for each polygon, i, and then summed during a given year, t.*

Methodology Section #	Equation #	Screenshot
8.1.3	4	Live biomass gain in year, *t*, polygon, *i* ($\Delta C_{BSL,G,i,t}$) is calculated as: $\Delta \mathbf{C_{BSL,G,t} = \Sigma(A_{BSL,i} \bullet G_{BSL,i,t}) \bullet CF}$ **(4)** where: $A_{BSL,i,}$ = area (ha) of forest land in polygon, *i*; $G_{BSL,i,t}$ = annual increment rate in tree biomass (t d.m. ha^{-1} yr^{-1}), in polygon, *i*, and; CF = carbon fraction of dry matter t C t^{-1} d.m. (IPCC default value = 0.5).
8.1.3	5a	$\mathbf{G_{BSL,i,t} = G_{BSL,AG,i,t} + G_{BSL,BG,i,t}}$ **(5a)** where: $G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above- and belowground biomass increment rates (t d.m. ha^{-1} yr^{-1});

Methodology Section #	Equation #	Screenshot
8.1.3	5b	$G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above- and belowground biomass increment rates (t d.m. ha^{-1} yr^{-1}); $$G_{BSL,BG,i,t} = G_{BSL,AG,i,t} \bullet R_i \quad \textbf{(5b)}$$ where R_i is the root:shoot ratio in polygon, *i*. R_i should ideally be estimated for each polygon, but these data are difficult to derive empirically. Hence, general relationships are acceptable as long as they are appropriate for the species and region associated with the project (Cairns, 1997). Equations 4 and 5 can be used directly to calculate $\Delta C_{BSL,G,t}$ when all tree cover within a polygon is removed by harvesting (i.e., clearfelling) and no residual structure is retained. In cases of partial harvesting and/or multiple entries into a polygon, these equations must be applied separately to each of the resulting sub-polygons (the different age classes that are created). This ensures that growth rates reflect the difference in forest age between the sub-polygons. The ex ante calculation of $G_{BSL,i,t}$ (either directly, or from its component parts) will be derived from models that require inputs derived, in part, from forest inventory data. Criteria for model suitability are provided in 8.1.1.1. The exact form of the input data depends on the nature of the model but may include site index, species composition, and volume.
8.1.4	6	$$\Delta C_{BSL,L,t} = \Sigma(LBL_{BSL,NATURALi,t} + LBL_{BSL,FELLINGS,i,t} + LBL_{BSL,OTHER,i,t}) \bullet CF \quad \textbf{(6)}$$ where: $LBL_{BSL,NATURALi,t}$ = annual loss of live tree biomass due to natural mortality in polygon, *i*; t d.m. yr^{-1} $LBL_{BSL,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, *i*; t d.m. yr^{-1} $LBL_{BSL,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, *i*; t d.m. yr^{-1} CF = carbon fraction of dry matter; t C t^{-1} d.m. (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.1.4	7[18]	$LBL_{BSL,NATURALi,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,NATURAL,i,t}$ (7)[18] where $A_{BSL,i}$ = area (ha) of forest land in polygon, *i*; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i,* for year, *t* $LB_{BSL,i,t}$ is calculated for year, *t*, beginning with biomass estimates in year *t*=1 (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5a. $f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon , *i* (unitless; $0 \leq f_{BSL,NATURALi} \leq 1$), year, *t*. Tree mortality is an ongoing process during stand development. Trees die as a consequence of insect attack, disease, competition, or some combination thereof. Hence, mortality can be highly variable between years. This parameter can be applied uniformly across an analysis unit, or individually to a given polygon. Sources for mortality estimates include permanent sample plots in similar stand types, literature reports, and inventory data.
8.1.4	8	$LBL_{FELLINGS,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,HARVEST,i,t}$ (8) where: $A_{BSL,i}$ = area (ha) of forest land in polygon, *i* $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i,* for year, *t* (see equation 7 for its calculation). $f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, *i,* (unitless; $0 \leq f_{BSL,HARVESTi} \leq 1$), in year, *t*. Data for this variable should be obtained from harvest schedule information. Values may be constrained by (a) the value of $f_{BSL,NATURAL,i,t}$ (i.e., $f_{BSL,HARVEST,i,t} < 1 - f_{BSL,NATURAL,i,t}$), and/or (b) the area of timber available for commercial harvest. Incidental loss ($LBL_{BSL,OTHER,i,t}$; t d.m. yr^{-1}) is the additional live tree biomass removed for road and landing construction in the polygon, *i*, and is calculated as a proportion of biomass removed by harvesting:

Methodology Section #	Equation #	Screenshot
8.1.4	9	$LBL_{BSL,OTHER,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,DAMAGE,i,t}$ (9) where: $A_{BSL,i}$ = area (ha) of forest land in polygon, *i*; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t* $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, *i*, year, *t* (unitless; $0 \leq f_{BSL,DAMAGE,i,t} \leq 1$)[19]. Data for this variable should be based on regional and local comparative studies and experiential information derived from the local forest industry[20].
8.1.5	10	The annual change in carbon stocks in DOM ($\Delta C_{BSL,DOM}$; t C yr^{-1}) is calculated as: $\Delta C_{BSL,DOM,t} = \Delta C_{BSL,LDW,t} + \Delta C_{BSL,SNAG,t} + \Delta C_{BSL,DBG,t}$ (10) where: $\Delta C_{BSL,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr^{-1} $\Delta C_{BSL,SNAG,t}$ = change in snag carbon stock in year, t; t C yr^{-1} $\Delta C_{BSL,DBG,t}$ = change in dead belowground biomass carbon stock in year, t; t C yr^{-1}.
8.1.5	11a	$\Delta C_{BSL,LDW,t} = \Sigma(LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t}) \bullet CF$ (11a)

Methodology Section #	Equation #	Screenshot
8.1.5	11b	$LDW_{BSL,i,t+1} = LDW_{BSL,i,t} + (LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t})$ **(11b)** where: $LDW_{BSL,,i,t}$ = The total mass of lying dead wood accumulated in polygon *i* , at time, *t* (t d.m.). $LDW_{BSL,IN,i,t}$ = annual increase in LDW biomass for polygon *i*, year, *t* (t d.m yr^{-1}). LDW increases occur as a result of natural mortality (typically, blowdown), and as a direct or indirect result of harvesting. $LDW_{BSL,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon *i*, year, *t*, (t d.m yr^{-1}) $LDW_{BSL,IN,i,t}$ and $LDW_{BSL,OUT,i,t}$ are summed across polygons. CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.1.5	12	$$LDW_{BSL,IN,i,t} = (LBL_{BSL,NATURALi,t} - LBL_{BSL,NATURALi,t} \bullet R_i) \bullet f_{BSL,BLOWDOWN,i,t} + ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet f_{BSL,BRANCH,i,t} + ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet f_{BSL,BUCKINGLOSS,i,t} + SNAG_{BSL,,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t} \quad (12)$$ where: $LBL_{BSL,NATURALi,t}$, $LBL_{BSL,FELLINGS,i,t,}$ and $LBL_{BSL,OTHER,i,t}$ are as calculated in equations 7, 8, and 9, respectively. R_i is the root:shoot ratio in polygon, *i* (see equation 5b). $f_{BSL,BLOWDOWN,i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, *i*, year, *t* (unitless; $0 \leq f_{BSL,BLOWDOWN,i,t} \leq 1$). Ex ante estimates must be derived preferably from regional reports in similar forest types. $f_{BSL,BRANCH,i,t}$ = the annual proportion of aboveground tree biomass comprised of branches $\geq$ 5 cm diameter in polygon, *i* (unitless; $0 \leq f_{BSL,BRANCH,i,t} \leq 1$). Ex ante data are available from allometric equations and models (for example, (Kurz & Apps, 2006) for Canada; (Smith, Miles, Vissage, & Pugh, 2004) for the U.S.). In the event slash burning was undertaken as part of regular management activities, this parameter should be reduced accordingly to reflect the proportion of biomass remaining. Estimates should be obtained from expert opinion; as a default, assume 100% consumption if slash burning occurs.

Methodology Section #	Equation #	Screenshot
		$f_{BSL,BUCKINGLOSS,i,t}$ = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, *i* (unitless; $0 \le f_{BSL,BUCKINGLOSS,i,t} \le 1$). Preferably, data for this variable must be based on regional and local comparative studies and experiential information derived from the local forest industry. Otherwise, an average default value of 21% can be used, based on US national summary statistics (Smith, Miles, Vissage, & Pugh, 2004). $SNAG_{BSL,,i,t}$ = the total mass of the snag pool in polygon, *i*, year, *t* (see equation 14b). $f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, *i*, year, *t*, that falls over and thus is transferred to the LDW pool (unitless; $0 \le f_{SNAGFALLDOWN,i,t} \le 1$). Ex ante estimates for this parameter can be derived from peer reviewed literature (for example, (Parish, Antos, Ott, & Di Lucca, 2010) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools (for example, (Kurz & et al, 2009).
8.1.5	13	$\mathbf{LDW_{BSL,OUT,i,t} = LDW_{BSL,,i,t} \bullet f_{BSL,lwDECAY,i,t}}$ **(13)** where: $LDW_{BSL,,i,t}$ = the total amount of lying deadwood mass in polygon *i*, year, *t (see equation 11b)*. $f_{BSL,lwDECAY,i,t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon *i*, year, *t* (unitless; ; $0 \le f_{BSL,lwDECAY,i,t} \le 1$). A common approach to ex ante estimation of $f_{BSL,lwDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with a single exponential model, of the general form: $Y_t = Y_o e^{-kt}$ where Y_o is the initial quantity of material, Y_t the amount left at time t, and k is a decay constant (Harmon, et al., 1986). Other types of exponential models are available (reviewed in (Harmon, et al., 1986)) and may be more appropriate to particular forest types (to be described and justified by the project proponent, if used). Ex ante estimates for the decay parameter appropriate for the project should be derived from peer-reviewed literature (for example, (Harmon, et al., 1986); (Laiho & and Prescott, 2004); (Harmon et al, 2008)).
8.1.5	14a	The change in standing dead wood (snag) carbon stock in year, t (t C yr^{-1}) is calculated as: $\mathbf{\Delta C_{BSL,SNAG,t} = \Sigma(SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t}) \bullet CF}$ **(14a)**

Methodology Section #	Equation #	Screenshot
8.1.5	14b	$SNAG_{BSL,i,t+1} = SNAG_{BSL,i,t} + (SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t})$ **(14b)** where: $SNAG_{BSL,i,t}$ = The total mass of snags accumulated in polygon *i, at time t (t d.m.).* $SNAG_{BSL,IN,i,t}$ = annual gain in snag biomass for polygon *i*, year, *t* (t d.m yr^{-1}). Snag biomass develops as a result of natural mortality. In cases where snags are created through management activities, these should be accounted for here. $SNAG_{BSL,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m yr^{-1}) CF = carbon fraction of dry matter (IPCC default value = 0.5). Note that $SNAG_{BSL,IN,i,t}$ and $SNAG_{BSL,OUT,i,t}$ are summed across polygons.
8.1.5	15	$SNAG_{BSL,IN,i,t} = (LBL_{BSL,NATURALi,t} - LBL_{BSL,NATURALi,t} \bullet R_i) \bullet (1 - f_{BSL,BLOWDOWN,i,t})$ **(15)** where: $LBL_{BSL,NATURALi,t}$ is as calculated in equation 7, and $1 - f_{BSL,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, *i*, year, *t*, but remains as standing dead organic matter (i.e., snags) (unitless; $0 \leq f_{BSL,BLOWDOWN,i,t} \leq 1$). Ex ante default estimates for this calculation can be derived from literature values (for example (Harmon, et al., 1986); (Runkle, 2000); (Harmon et al, 2008)) and should be matched to the ecosystems that most closely characterize the project area.

Methodology Section #	Equation #	Screenshot
8.1.5	16	$$SNAG_{BSL,OUT,i,t} = SNAG_{BSL,i,t} \bullet f_{BSL,SWDECAY,i,t} + SNAG_{BSL,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t} \quad (16)$$ where: $SNAG_{BSL,i,t}$ = the total amount of snag mass in polygon *i*, year, *t* (see equation 14b). $f_{BSL,SWDECAY,i,t}$ = the annual proportional loss of snag biomass due to decay, in polygon, *i*, year, *t* (unitless; $0 \leq f_{BSL,SWDECAY,i,t} \leq 1$). As with lying dead wood, a common approach to estimating $f_{BSL,SWDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with a single exponential model (see equation 13). Ex ante estimates for this parameter should be derived from peer reviewed literature appropriate for the project site (for example, Vanderwel et al. 2006a) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools for each forest type, productivity, and age-class (see, for example, Vanderwel et al., 2006b; (Kurz & et al, 2009)). $f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, *i*, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{BSL,SNAGFALLDOWN,i,t} \leq 1$). See equation 12 for parameter estimates. The annual change in DOM derived from dead belowground biomass ($\Delta C_{BSL,DBG,,t}$; t C yr^{-1}) is calculated for each polygon as per equation 17a. Calculation of $\Delta C_{BSL,DBG,t}$ is specific to a given polygon; each polygon must therefore be summed in order to calculate total annual loss across the project activity area.
8.1.5	17a	$$\Delta C_{BSL,DBG,t} = \Sigma(DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \bullet CF \quad (17a)$$
8.1.5	17b	$$DBG_{BSL,i,t+1} = DBG_{BSL,i,t} + (DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \quad (17b)$$ where: $DGB_{BSL,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon *i*, at time, *t* (t d.m.). $DBG_{BSL,IN,i,t}$ = annual gain in dead belowground biomass for polygon *i*, year, *t* (t d.m yr^{-1}). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities. $DBG_{BSL,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m yr^{-1}) CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.1.5	17c	$DBG_{BSL,IN,i,t} = [(A_{BSL,i} \bullet LB_{BSL,i,t} \bullet R_i) \bullet (f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t})]$ **(17c)** where: $A_{BSL,i}$ = area (ha) of forest land in polygon, *i*; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t*. $LB_{BSL,i,t}$ is calculated for year, *t*, beginning with biomass estimates in year *t*=1 (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5 a, b. This value is then multiplied by $A_{BSL,i}$, the area (ha) of forest land in polygon, *i*. R_i is the root:shoot ratio in polygon, *i* (see equation 5b). $f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, *i* (unitless; $0 \leq f_{NATURALi} \leq 1$), year, *t* (see equation 7), $f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, *i*, (unitless; $0 \leq f_{HARVESTi} \leq 1$), year, *t* (see equation 8), $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed or road and landing construction in polygon, *i* (unitless; $0 \leq f_{DAMAGE,i,t} \leq 1$), year, *t* (see equation 9)
8.1.5	17d	$DBG_{BSL,OUT,i,t} = DBG_{BSL,i,t} \bullet f_{BSL,dgbDECAY,i,t}$ **(17d)** where: $DBG_{BSL,i,t}$ = the total quantity of dead belowground in polygon *i*, year, *t* (see equation 17b). $f_{BSL,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon *i*, year, *t* (unitless; ; $0 \leq f_{BSL,lwDECAY,i,t} \leq 1$). The ex ante estimation of the decay of dead belowground biomass should be done using a similar single exponent decay function as that described above for lying deadwood biomass. Estimates for the decay parameter appropriate for specific project should be derived from peer-reviewed literature (see for example: (Moore, Trofymow, Siltanen, Prescott, & CIDET, 2005)); Melin et al. (2009); (Melin, Petersson, & Nordfjell, 2009)).

Methodology Section #	Equation #	Screenshot
8.1.6	18	The annual change emissions associated with the production of harvested wood products (HWP), $\Delta C_{BSl,HWP,t}$, is calculated as: $\Delta C_{BSl,HWP,t} = \Delta C_{BSL,STORHWP,t} - \Delta C_{BSL,EMITFOSSIL,t,}$ **(18)** $\Delta C_{BSL,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr^{-1}) $\Delta C_{BSL,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.
8.1.7	19	The annual change in carbon storage in harvested wood products in year *t* ($\Delta C_{BSL,STORHWP,t}$; t C yr^{-1}) is determined based upon the following equation: $\Delta C_{BSL,STORHWP,t} = (C_{BSL,STORHWP,t2} - C_{BSL,STORHWP,t1}) / T$ **(19)** where: $C_{BSL,STORHWP,t2}$ = carbon storage in harvested wood products at t=2; t C $C_{BSL,STORHWP,t1}$ = carbon storage in harvested wood products at t=1; t C T = number of years between monitoring t1 and t2 t : 1,2,3…t years elapsed since the project start date

Methodology Section #	Equation #	Screenshot
8.1.7	20	$$C_{BSL,TIMBER,h} = \Sigma[(LBL_{BSL,FELLINGS,i,h} - LBL_{BSL,FELLINGS,i,h} \bullet R_i + LBL_{BSL,OTHER,i,h} - LBL_{BSL,OTHER,i,h} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,h}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,h})] \bullet CF \quad (20)$$ where: $C_{BSL,TIMBER,h}$= carbon contained in timber harvested in period *h* (summed for all harvested polygons, *i*); t C $LBL_{BSL,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, *i*; t d.m. (equation 8) $LBL_{BSL,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, *i*; t d.m. (equation 9) R_i is the root:shoot ratio in polygon, *i* (see equation 5b). 1 - $f_{BSL,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon *i* (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) 1 - $f_{BSL,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, *i* (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 12) h = harvest period ; yr
8.1.7	21	$$C_{BSL,MILL,h,k} = (C_{BSL,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k}) \quad (21)$$

Methodology Section #	Equation #	Screenshot
		where: $C_{BSL,MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type *k*; t C $C_{BSL,TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type *k*; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) $f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type *k* (default values by region in Table 1.5 of the 1605(b) document); dimensionless $r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type *k* (default values by region in Table 1.5 of the 1605(b) document); dimensionless
8.1.7	22a	Three values are then calculated from these data selected from Table 1.6 in the 1605(b) document, for each product type, *k* : the short-lived fraction ($P_{BSL,SLF,k}$), medium-lived fraction ($P_{BSL,MLF,k}$), and long-lived fraction ($P_{BSL,LLF,k}$): $P_{BSL,SLF,k} = 1\text{-}P_{3\text{-}year}$ **(22a)**
8.1.7	22b	$P_{BSL,LLF,k} = P_{100\text{-}year}$ **(22b)**
8.1.7	22c	$P_{BSL,MLF,k} = P_{3\text{-}year} - P_{100\text{-}year}$, **(22c)**

Methodology Section #	Equation #	Screenshot
8.1.7	23	$C_{BSL,STORHWP,t,} = \Sigma\,\Sigma\,((\,C_{BSL,MILL,h,k} \bullet P_{LLF,k}) + [(C_{BSL,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20\text{-}h) / 20)])$ **(23)** where: $C_{BSL,STORHWP,t,}$ = carbon stored in harvested wood products in year *t* summed for all product types *k* and then over all harvest periods *h*; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) h = year of harvest (the term (20-h) should not be allowed to drop below 0)
8.1.8	24	The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as: $C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t}$ **(24)** where: $C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr^{-1}) $C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr^{-1}) $C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr^{-1})

Methodology Section #	Equation #	Screenshot
8.1.8	25	The simplest approach to calculating $C_{BSL,EMITFOSSIL,t}$ is to use published or derived carbon emission intensity factors. In the case of harvesting, $_{BSL,}C_{EMITHARVEST,t}$; t C yr^{-1}), can be calculated (summed across harvested polygons)as: $$C_{BSL,EMITHARVEST,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet c_{HARVEST} \quad (25)$$ where: $c_{HARVEST}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting (see Table 4 for default values); all other terms are as defined in equation 20.
8.1.8	26	$C_{BSL,EMITTRANSPORT,t}$ must be calculated after consideration of the transport distance from harvest to processing facility, and the means of transportation. This term can be calculated as follows (after (Heath, et al., 2010)): $$C_{BSL,EMITTRANSPORT,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet \Sigma(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk}) \quad (26)$$ where: $f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, *k*. (unitless; $0 \leq f_{BSL,TRANSPORTk} < 1$). $d_{TRANSPORTk}$ = the distance transported by transportation type, *k*. (km); $c_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k (see Table 4 for default values); all other terms are as defined in equation 20.

Methodology Section #	Equation #	Screenshot
8.1.8	27	$$\mathbf{C_{BSL,EMITMANUFACTURE,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet \Sigma(f_{BSL,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF} \quad \textbf{(27)}$$ $c_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, *k*; all other terms are as defined in equation 19.
8.2.3	28a	Actual (ex post) annual net carbon stocks are calculated using the equations in this section. $$\mathbf{C_{ACTUAL,i,t} = C_{LB,i,t} + C_{DOM,i,t}} \quad \textbf{(28a)}$$ where: $C_{ACTUAL,i,t}$ = carbon stocks in all selected carbon pools in polygon, *i*, year, *t*; t C $C_{LB,i,t}$ = carbon stocks in living tree biomass in polygon, *i*, year, *t*; t C $C_{DOM,i,t}$ = carbon stocks in dead organic matter in year, *t*; t C
8.2.3	28b	$$\mathbf{B_{TOTAL,i,t} = (B_{AG,i,t} + B_{BG,i,t})} \quad \textbf{(28b)}$$

Methodology Section #	Equation #	Screenshot
8.2.3	28c	$C_{LB,i,t} = (B_{TOTAL,i,t}) \bullet CF$ **(28c)** where: $B_{AG,i,t}$ = aboveground tree biomass (t d.m. ha^{-1}) measured in polygon, *i,* year, *t* $B_{BG,i,t}$ = belowground tree biomass (t d.m. ha^{-1}) measured in polygon, *i,* year, *t.* $B_{TOTAL,i,t}$ = total tree biomass (t d.m. ha^{-1}) measured in polygon, *i,* year, *t*
8.2.3	28e	$C_{DOM,i,t} = (DOM_{LDW,i,t} + DOM_{SNAG,i,t}) \bullet CF$ **(28e)** where: $DOM_{LDW,i,t}$ = average mass of dead organic matter contained in lying dead wood (t d.m. ha^{-1}) in measured in polygon, *i,* year, *t* $DOM_{SNAG,i,t}$ = average mass of dead organic matter contained in standing snags (t d.m. ha^{-1}) in measured in polygon, *i,* year, *t* The average quantity of dead organic matter contained in lying dead wood for measured polygon, *i,* in year, *t* ($DOM_{LDW,i,t}$) is calculated according to equations 60a-c in Section 9.3.2. The value of $DOM_{LDW,i,t}$ must be compared to the equivalent calculation of lying dead wood mass ($LDW_{PRJ,i,t}$) in the project scenario (Section 8.2.8) (see comparison method and steps below).
8.2.5	29	The total annual carbon balance in year, t, for the project scenario is calculated as ($\Delta C_{PRJ,t}$, in t C yr^{-1}): $\Delta C_{PRJ,t} = \Delta C_{PRJ,P,t}$ **(29)** where: $\Delta C_{PRJ,P,t}$ is the annual change in carbon stocks in all pools in the project across the project activity area; t C yr^{-1} .

Methodology Section #	Equation #	Screenshot
8.2.5	30	$\Delta C_{PRJ,P,t} = \Delta C_{PRJ,LB,t} + \Delta C_{PRJ,DOM,t} + \Delta C_{PRJ,HWP,t}$ **(30)** $\Delta C_{PRJ,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr^{-1} $\Delta C_{PRJ,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr^{-1} $\Delta C_{PRJ,HWP,t}$ is the annual change in carbon stocks associated with harvested wood products, t C yr^{-1}.
8.2.5	31	$\Delta C_{PRJ,LB,t} = \Delta C_{PRJ,G,t} - \Delta C_{PRJ,L,t}$ **(31)** where: $\Delta C_{PRJ,G,t}$ = annual increase in tree carbon stock from growth; t C yr^{-1} $\Delta C_{PRJ,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr^{-1}.
8.2.6	32	Live biomass gain in year, *t*, polygon, *i* ($\Delta C_{PRJ,G,i,t}$) is calculated as: $\Delta C_{PRJ,G,t} = \Sigma(A_{PRJ,i} \bullet G_{PRJ,i,t}) \bullet CF$ **(32)** where: $A_{PRJ,i,}$ = area (ha) of forest land in polygon, *i*; $G_{PRJ,i,t}$ = annual increment rate in tree biomass (t d.m. ha^{-1} yr^{-1}), in polygon, *i*, and; CF = carbon fraction of dry matter t C t^{-1} d.m. (IPCC default value = 0.5).
8.2.6	33a	$G_{PRJ,i,t} = G_{PRJ,AG,i,t} + G_{PRJ,BG,i,t}$ **(33a)** where $G_{PRJ,AG,i,t}$ and $G_{PRJ,BG,i,t}$ are the annual above- and belowground biomass increment rates (t d.m. ha^{-1} yr^{-1});

Methodology Section #	Equation #	Screenshot
8.2.6	33b	$$G_{PRJ,BG,i,t} = G_{PRJ,AG,i,t} \bullet R_i \qquad (33b)$$ where R_i is the root:shoot ratio in polygon, *i*. R_i should ideally be estimated for each polygon, but these data are difficult to derive empirically. Hence, general relationships are acceptable (Cairns, 1997).
8.2.7	34	$$\Delta C_{PRJ,L,t} = \Sigma(LBL_{PRJ,NATURALi,t} + LBL_{PRJ,FELLINGS,i,t} + LBL_{PRJ,OTHERi,t}) \bullet CF \qquad (34)$$ where: $LBL_{PRJ,NATURALi,t}$ = annual loss of live tree biomass due to natural mortality in polygon, *i*; t d.m. yr^{-1} $LBL_{PRJ,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, *i*; t d.m. yr^{-1} $LBL_{PRJ,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, *i*; t d.m. yr^{-1} CF = carbon fraction of dry matter; t C t^{-1} d.m. (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.2.7	35[24]	$LBL_{PRJ,NATURALi,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,NATURAL,i,t}$ **(35)**[24] where $A_{PRJ,i}$ = area (ha) of forest land in polygon, *i*; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t* $LB_{PRJ,i,t}$ is calculated for year, *t*, beginning with biomass estimates in year *t*=1 (the project start year) and with annual biomass increments ($G_{PRJ,i,t}$) added as per calculations in equation 33a. $f_{PRJ,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in forest type , *i* (unitless; $0 \leq f_{PRJ,NATURALi} \leq 1$), year, *t*. Tree mortality is an ongoing process during stand development. Trees die as a consequence of insect attack, disease, competition, or some combination thereof. Hence, mortality can be highly variable between years. This parameter can be applied uniformly across an analysis unit, or individually to a given polygon. Ex post estimates from regional data sources in corresponding stand types are preferred. Sources for mortality estimates include permanent sample plots in similar stand types, literature reports, and inventory data. Some models (the FORECAST model, for example) simulate annual background mortality rates directly and can accommodate variable age structures following partial harvesting.
8.2.7	36	$LBL_{PRJ,FELLINGS,i,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,HARVEST,i,t}$ **(36)** where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, *i* $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t* (see equation 7 for its calculation). $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, *i*, (unitless; $0 \leq f_{PRJ,HARVESTIi} \leq 1$), in year, *t*. Data for this variable should be obtained from harvest schedule information. Values may be constrained by (a) the value of $f_{PRJ,NATURAL,i,t}$ (i.e., $f_{PRJ,HARVEST,i,t} < 1 - f_{PRJ,NATURAL,i,t}$), and/or (b) the area of timber available for commercial harvest.

Methodology Section #	Equation #	Screenshot
8.2.7	37	Incidental loss ($LBL_{PRJ,OTHER,i,t}$; t d.m. yr^{-1}) is the additional live tree biomass removed for road and landing construction in the polygon, *i*, and is calculated as a proportion of biomass removed by harvesting: $$LBL_{PRJ,OTHER,i,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,HARVEST,i,t} \bullet f_{PRJ,DAMAGE,i,t} \quad (37)$$ where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, *i*; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t* $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, *i*, in year, *t* (unitless; $0 \leq f_{PRJ,HARVEST,i,t} \leq 1$). $f_{PRJ,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, *i*, year, *t* (unitless; $0 \leq f_{PRJ,DAMAGE,i,t} \leq 1$)[25]. Data for this variable should be based on regional and local comparative studies and experiential information derived from the local forest industry[26].
8.2.8	38	The annual change in carbon stocks in DOM ($\Delta C_{PRJ,DOM}$; t C yr^{-1}) is calculated as: $$\Delta C_{PRJ,DOM,t} = \Delta C_{PRJ,LDW,t} + \Delta C_{PRJ,SNAG,t} + \Delta C_{PRJ,DBG,t} \quad (38)$$ where: $\Delta C_{PRJ,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, *t*; t C yr^{-1} $\Delta C_{PRJ,SNAG,t}$ = change in snag carbon stock in year, *t*; t C yr^{-1} $\Delta C_{BSL,DBG,t}$ = change in belowground carbon stock in year, *t*; t C yr^{-1}.
8.2.8	39a	$$\Delta C_{PRJ,LDW,t} = \Sigma(LDW_{PRJ,IN,i,t} - LDW_{PRJ,OUT,i,t}) \bullet CF \quad (39a)$$

Methodology Section #	Equation #	Screenshot
8.2.8	39b	$LDW_{PRJ,i,t+1} = LDW_{PRJ,i,t} + (LDW_{PRJ,IN,i,t} - LDW_{PRJ,OUT,i,t})$ **(39b)** where: $LDW_{PRJ,i,t}$= The total mass of lying dead wood accumulated in polygon *i* at time t (t d.m.). $LDW_{PRJ,IN,i,t}$ = annual increase in LDW biomass for polygon *i*, year, *t* (t d.m ha^{-1} yr^{-1}). LDW increases occur as a result of natural mortality (typically, blowdown), and as a direct or indirect result of harvesting. $LDW_{PRJ,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon *i*, year, *t*, (t d.m ha^{-1} yr^{-1}) $LDW_{PRJ,IN,i,t}$ and $LDW_{PRJ,OUT,i,t}$ are summed across polygons. CF = carbon fraction of dry matter (IPCC default value = 0.5).
8.2.8	40	$LDW_{PRJ,IN,i,t} = (LBL_{PRJ,NATURALi,t} - LBL_{PRJ,NATURALi,t} \bullet R_i) \bullet f_{PRJ,BLOWDOWN,i,t} +$ $((LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i) +$ $(LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i)) \bullet f_{PRJ,BRANCH,i,t} +$

		$$((\mathbf{LBL}_{PRJ,FELLINGS,i,t} - \mathbf{LBL}_{PRJ,FELLINGS,i,t} \bullet \mathbf{R}_i) + (\mathbf{LBL}_{PRJ,OTHER,i,t} - \mathbf{LBL}_{PRJ,OTHER,i,t} \bullet \mathbf{R}_i)) \bullet (1 - \mathbf{f}_{PRJ,BRANCH,i,t}) \bullet \mathbf{f}_{PRJ,BUCKINGLOSS,i,t} + \mathbf{SNAG}_{PRJ,,i,t} \bullet \mathbf{f}_{PRJ,SNAGFALLDOWN,i,t} \quad \mathbf{(40)}$$ where: $LBL_{PRJ,NATURAL,i,t}$, $LBL_{PRJ,FELLINGS,i,t}$ and $LBL_{PRJ,OTHER,i,t}$ are as calculated in equations 35, 36, and 37, respectively. R_i is the root:shoot ratio in polygon, *i* (see equation 33b). $f_{PRJ,BLOWDOWN,i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, *i*, year, *t* (unitless; $0 \leq f_{PRJ,BLOWDOWN,i,t} \leq 1$). Ex ante estimates must be derived from regional reports in similar forest types. $f_{PRJ,BRANCH,i,t}$ = the annual proportion of aboveground tree biomass comprised of branches $\geq$ 5 cm diameter in polygon, *i* (unitless; $0 \leq f_{PRJ,BRANCH,i,t} \leq 1$). Ex ante data are available from allometric equations and models (for example, (Kurz & Apps, 2006) for Canada; (Smith, Miles, Vissage, & Pugh, 2004) for the U.S.). In the event slash burning is undertaken, this parameter should be reduced accordingly to reflect the proportion of biomass remaining. Estimates should be obtained from expert opinion; as a default, assume 100% consumption. $f_{PRJ,BUCKINGLOSS,i,t}$ = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, *i* (unitless; $0 \leq f_{PRJ,BUCKINGLOSS,i,t} \leq 1$). Preferably, data for this variable must be based on regional and local comparative studies and experiential information derived from the local forest industry Otherwise, an average default value of 21% can be used, based on US national summary statistics (Smith, Miles, Vissage, & Pugh, 2004). $SNAG_{PRJ,i,t}$ = the total mass of the snag pool in polygon, *i*, year, *t* (see equation 42b). $f_{PRJ,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, *i*, year, *t*, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$). Ex ante estimates for this parameter can be derived from peer reviewed literature (for example, (Parish, Antos, Ott, & Di Lucca, 2010) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools (for example, (Kurz & et al, 2009).

Methodology Section #	Equation #	Screenshot
8.2.8	41	$\mathbf{LDW_{PRJ,OUT,i,t} = LDW_{PRJ,i,t} \bullet f_{PRJ,lwDECAY,i,t}}$ **(41)** where: $LDW_{PRJ,i,t}$ = the total amount of lying deadwood mass in polygon *i*, year, *t (see equation 39b)*. $f_{PRJ,lwDECAY,i,t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon *i*, year, *t* (unitless; ; $0 \leq f_{PRJ,lwDECAY,i,t} \leq 1$). A common approach to ex ante estimation of $f_{PRJ,lwDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with an a single exponential model, of the general form: $Y_t = Y_o e^{-kt}$ where Y_o is the initial quantity of material, Y_t the amount left at time *t*, and k is a decay constant (Harmon, et al., 1986). Other types of exponential models are available (reviewed in (Harmon, et al., 1986)) and may be more appropriate to particular forest types (to be described and justified by the project proponent, if used). Ex ante estimates for the decay parameter appropriate for the project should be derived from peer-reviewed literature (for example, (Harmon, et al., 1986); (Laiho & and Prescott, 2004); (Harmon et al, 2008)).
8.2.8	42a	The change in standing dead wood (snag) carbon stock in year, *t* (t C yr^{-1}) is calculated as: $\mathbf{\Delta C_{PRJ,SNAG,t} = \Sigma(SNAG_{PRJ,IN,i,t} - SNAG_{PRJ,OUT,i,t}) \bullet CF}$ **(42a)**

Methodology Section #	Equation #	Screenshot
8.2.8	42b	$$SNAG_{PRJ,i,t+1} = SNAG_{PRJ,i,t} + (SNAG_{PRJ,IN,i,t} - SNAG_{PRJ,OUT,i,t}) \quad \textbf{(42b)}$$ where: $SNAG_{PRJ,i,t}$ = The total mass of snags accumulated in polygon *i* at time *t* (t d.m.) $SNAG_{PRJ,IN,i,t}$ = annual gain in snag biomass for polygon *i*, year, *t* (t d.m ha^{-1} yr^{-1}). Snag biomass develops as a result of natural mortality. In cases where snags are created through management activities, these should be accounted for here. $SNAG_{PRJ,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m ha^{-1} yr^{-1}) CF = carbon fraction of dry matter (IPCC default value = 0.5). Note that $SNAG_{PRJ,IN,i,t}$ and $SNAG_{PRJ,OUT,i,t}$ are summed across polygons.
8.2.8	43	$$SNAG_{PRJ,IN,i,t} = (LBL_{PRJ,NATURALi,t} - LBL_{PRJ,NATURALi,t} \bullet R_i) \bullet (1 - f_{PRJ,BLOWDOWN,i,t}) \quad \textbf{(43)}$$ where: $LBL_{PRJ,NATURALi,t}$ is as calculated in equation 35, and $1 - f_{PRJ,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, *i*, year, *t*, but remains as standing dead organic matter (i.e. snags) (unitless; $0 \leq f_{PRJ,BLOWDOWN,i,t} \leq 1$). Ex ante default estimates for this calculation can be derived from literature values (for example (Harmon, et al., 1986); (Runkle, 2000); (Harmon et al, 2008)) and should be matched to the ecosystems that most closely characterize the project area.

Methodology Section #	Equation #	Screenshot
8.2.8	44	$SNAG_{PRJ,OUT,i,t} = SNAG_{PRJ,i,t} \bullet f_{PRJ,SWDECAY,i,t} + SNAG_{PRJ,i,t} \bullet f_{PRJ,SNAGFALLDOWN,i,t}$ **(44)** where: $SNAG_{PRJ,i,t}$ = the total amount of snag mass in polygon *i*, year, *t (see equation 42b)*. $f_{PRJ,SWDECAY,i,t}$ = the annual proportional loss of snag biomass due to decay, in polygon, *i*, year, *t* (unitless; $0 \leq f_{PRJ,SWDECAY,i,t} \leq 1$). As with lying dead wood, a common approach to estimating $f_{PRJ,SWDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with an a single exponential model (see equation 41). Ex ante estimates for this parameter can be derived from peer reviewed literature appropriate for the project site (for example, Vanderwel et al. 2006a) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools for each forest type, productivity, and age-class (see, for example, Vanderwel et al., 2006b; (Kurz & et al, 2009)). $f_{PRJ,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, *i*, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$). See equation 40 for parameter estimates.
8.2.8	45a	$\Delta C_{PRJ,DBG,t} = \Sigma(DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t}) \bullet CF$ **(45a)**

Methodology Section #	Equation #	Screenshot
8.2.8	45b	$$DBG_{PRJ,i,t+1} = DBG_{PRJ,i,t} + (DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t}) \quad \textbf{(45b)}$$ where: $DGB_{PRJ,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon *i* at time *t* (t d.m.). $DBG_{PRJ,IN,i,t}$ = annual gain in dead belowground biomass for polygon *i*, year, *t* (t d.m ha^{-1} yr^{-1}). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities. $DBG_{PRJ,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m ha^{-1} yr^{-1}) CF = carbon fraction of dry matter (IPCC default value = 0.5).
8.2.8	45c	$$DBG_{PRJ,IN,i,t} = [(A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet R_i) \bullet (f_{PRJ,NATURAL,i,t} + f_{PRJ,HARVEST,i,t} + f_{PRJ,DAMAGE,i,t})] \quad \textbf{(45c)}$$ where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, *i*; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha^{-1}) in polygon, *i*, for year, *t*. $LB_{PRJ,i,t}$ is calculated for year, *t*, beginning with biomass estimates in year *t*=1 (the project start year) and with annual biomass increments ($G_{PRJ,i,t}$) added as per calculations in equation 33 a, b. This value is then multiplied by $A_{PRJ,i,}$ the area (ha) of forest land in polygon, *i*. R_i is the root:shoot ratio in polygon, *i* (see equation 33b). $f_{PRJ,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, *i* (unitless; $0 \leq f_{NATURALi} \leq 1$), year, *t* (see equation 35), $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, *i*, (unitless; $0 \leq f_{PRJ,HARVESTi} \leq 1$), year, *t* (see equation 36), $f_{PRJ,DAMAGE,i,t}$ = the proportion of additional biomass removed by for road and landing construction in polygon, *i* (unitless; $0 \leq f_{PRJ,DAMAGE,i,t} \leq 1$), year, *t* (see equation 37),

Methodology Section #	Equation #	Screenshot
8.2.8	45d	$\mathbf{DBG_{PRJ,OUT,i,t} = DBG_{PRJ,i,t} \bullet f_{PRJ,dgbDECAY,i,t}}$ **(45d)** where: $DBG_{PRJ,i,t}$ = the total quantity of dead belowground in polygon *i*, year, *t (equation 17b)*. $f_{PRJ,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon *i*, year, *t* (unitless; $0 \leq f_{PRJ,lwDECAY,i,t} \leq 1$). The ex ante estimation of the decay of dead belowground biomass should be done using a similar single exponent decay function as that described above for lying deadwood biomass. Estimates for the decay parameter appropriate for specific project should be derived from peer-reviewed literature (see for example: (Moore, Trofymow, Siltanen, Prescott, & CIDET, 2005); (Melin, Petersson, & Nordfjell, 2009).
8.2.9	46	$\mathbf{\Delta C_{PRJ,HWP,t} = \Delta C_{PRJ,STORHWP,t} - \Delta C_{PRJ,EMITFOSSIL,t},}$ **(46)** $\Delta C_{PRJ,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr^{-1}) $\Delta C_{PRJ,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.

Methodology Section #	Equation #	Screenshot
8.2.10	47	The annual change in carbon storage in harvested wood products in year *t* ($\Delta C_{PRJ,STORHWP,t}$; t C yr^{-1}) is determined based upon the following equation: $\Delta C_{PRJ,STORHWP,t} = (C_{PRJ,STORHWP,t2} - C_{PRJ,STORHWP,t1}) / T$ **(47)** where: $C_{PRJ,STORHWP,t2}$ = carbon storage in harvested wood products at t=2; t C $C_{PRJ,STORHWP,t1}$ = carbon storage in harvested wood products at t=1; t C T = number of years between monitoring t1 and t2 t : 1,2,3…t years elapsed since the project start date
8.2.10	48	$C_{PRJ,TIMBER,h} = \Sigma[(LBL_{PRJ,FELLINGS,i,h} - LBL_{PRJ,FELLINGS,i,h} \bullet R_i + LBL_{PRJ,OTHER,i,h} - LBL_{PRJ,OTHER,i,h} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,h}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,h})] \bullet \bullet CF$ **(48)** where:

Methodology Section #	Equation #	Screenshot
		$C_{PRJ,TIMBER,h}$= carbon contained in timber harvested in period *h* (summed for all harvested polygons, *i*); t C $LBL_{PRJ,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, *i*; t d.m. (equation 36) $LBL_{PRJ,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, *i*; t d.m. (equation 37) R_i is the root:shoot ratio in polygon, *i* (see equation 33b). 1 - $f_{PRJ,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon *i* (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) 1 - $f_{PRJ,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, *i* (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 40) h = harvest period ; yr
8.2.10	49	$$C_{PRJ,MILL,h,k} = (C_{PRJ,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k}) \qquad (49)$$ where: $C_{PRJ,MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type *k*; t C $C_{PRJ,TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type *k*; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) $f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type *k* (default values by region in Table 1.5 of the 1605(b) document); dimensionless $r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type *k* (default values by region in Table 1.5 of the 1605(b) document); dimensionless

Methodology Section #	Equation #	Screenshot
8.2.10	50a	To determine the proportion of harvested wood products (by type) that fall into each category, refer to the "In Use" column for the selected forest region in Table 1.6 in the 1605(b) document. Table 3 provides recommendations for analogs for areas within North America but outside of the conterminous US; the project proponent must justify the appropriateness of the selected analog .Three values are then calculated from these data selected from Table 1.6 in the 1605(b) document, for each product type, *k* : the short-lived fraction ($P_{PRJ,SLF,k}$), medium-lived fraction ($P_{PRJ,MLF,k}$), and long-lived fraction ($P_{PRJ,LLF,k}$): $$\mathbf{P_{PRJ,SLF,k} = 1\text{-}P_{3\text{-}year}} \quad \mathbf{(50a)}$$
8.2.10	50b	$$\mathbf{P_{PRJ,LLF,k} = P_{100\text{-}year}} \quad \mathbf{(50b)}$$
8.2.10	50c	$$\mathbf{P_{PRJ,MLF,k} = P_{3\text{-}year} - P_{100\text{-}year}} \, , \quad \mathbf{(50c)}$$ Each category of wood products (*k*) stores carbon according to the following rules: iv. Short-lived wood products – immediate emission of all carbon upon harvest v. Medium-lived wood products – no emission of carbon upon harvest, but carbon stored will decrease by 1/20th for the next 20 years after harvest, such that after 20 years the term becomes zero vi. Long-lived wood products – no loss of carbon.

Methodology Section #	Equation #	Screenshot
8.2.10	51	$C_{PRJ,STORHWP,t,} = \Sigma\,\Sigma\,((C_{PRJ,MILL,h,k} \bullet P_{LLF,k}) + [(C_{PRJ,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20\text{-}h) / 20)])$ **(51)** where: $C_{PRJ,STORHWP,t,}$ = carbon stored in harvested wood products in year *t* summed for all product types *k* and then over all harvest periods *h*; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) h = year of harvest (the term (20-h) should not be allowed to drop below 0)
8.2.11	52	The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{PRJ,EMITFOSSIL,t}$) are calculated as: $\Delta C_{PRJ,EMITFOSSIL,t} = C_{PRJ,EMITHARVEST,t} + C_{PRJ,EMITMANUFACTURE,t} + C_{PRJ,EMITTRANSPORT,t}$ **(52)** Where $C_{PRJ,EMITHARVEST,t}$ = the annual fossil fuel emissions associated with harvesting of raw material (t C yr^{-1}) $C_{PRJ,EMITMANUFACTURE,t}$ = the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr^{-1}) $C_{PRJ,EMITTRANSPORT,t}$ = the annual fossil fuel emissions associated with the transport of raw material (t C yr^{-1})

Methodology Section #	Equation #	Screenshot
8.2.11	53	The simplest approach to calculating $C_{PRJ,EMITFOSSIL,t}$ is to use published or derived carbon emission intensity factors. In the case of harvesting, $_{PRJ,}C_{EMITHARVEST,t}$; t C yr^{-1}), can be calculated as: $$C_{PRJ,EMITHARVEST,t} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet c_{HARVEST} \quad (53)$$ where: $c_{HARVEST}$ = carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting (see Table 4 for default values); all other terms are as defined in equation 19.
8.2.11	54	$C_{PRJ,EMITTRANSPORT,t}$ must be calculated after consideration of the transport distance from harvest to processing facility, and the means of transportation. This term can be calculated as follows (after (Heath, et al., 2010)): $$C_{PRJ,EMITTRANSPORT,t} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet \Sigma(f_{PRJ,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk}) \quad (54)$$ where: $f_{PRJ,TRANSPORTk}$ = the fraction of raw material transported by transportation type, *k*. (unitless; $0 \leq f_{PRJ,TRANSPORTk} < 1$). $d_{TRANSPORTk}$ = the distance transported by transportation type, *k*. (km); $c_{TRANSPORTk}$ = the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, *k* (see Table 4 for default values); all other terms are as defined in equation 48.

Methodology Section #	Equation #	Screenshot
8.2.11	55	$C_{PRJ,EMITMANUFACTURE,t} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet \Sigma(f_{PRJ,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF$ **(55)** $c_{MANUFACTUREk}$ = the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k; all other terms are as defined in equation 48.
8.3.3	56a	For project proponents using Market Leakage Option 1: **The outcome of the VCS Leakage Discount Factor determination = the value for MLF_y (56a)**
8.3.3	56b	To calculate the project market leakage (LE_Y, t CO2e yr^{-1}): $LE_Y = MLF_y \cdot ER_{y,GROSS}$ **(56b)** Where, MLF_y = Market leakage factor, as calculated above. $ER_{y,GROSS}$ = the gross difference in the overall annual carbon change between the baseline and project scenarios in year 'y' (in tonnes CO_2e yr^{-1}). This term is calculated in equation 57.

Methodology Section #	Equation #	Screenshot
8.3.4	56c.1	$$BC_{hv,n} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,Other,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet 44/12 \quad (56c.1)$$ As calculated using the *baseline scenario data*, and where: $LBL_{BSL,FELLINGS,i,t}$ = annual removal of live tree biomass due to commercial felling in polygon, *i*; t d.m. yr^{-1} (equation 6) $LBL_{BSL,OTHER,i,t}$ = annual removal of live tree biomass from incidental sources in polygon, *i*; t d.m. yr^{-1} (equation 6) $1 - f_{BSL,BRANCH,i,t}$ = the proportion of aboveground live tree biomass remaining after netting out branch biomass, in polygon *i* (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) $1 - f_{BSL,BUCKINGLOSS,i,t}$ = the proportion of the log bole remaining after processing for quality, in polygon, *i* (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 12) R_i = the root:shoot ratio in polygon, *i* CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.3.4	56c.2	$$AC_{hv,n} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,Other,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet 44/12 \quad (56c.2)$$ As calculated using the *project scenario data*, and where: $LBL_{PRJ,FELLINGS,i,t}$ = annual removal of live tree biomass due to restoration felling in polygon, *i*; t d.m. yr^{-1} (equation 6) $LBL_{PRJ,OTHER,i,t}$ = annual removal of live tree biomass from incidental sources in polygon, *i*; t d.m. yr^{-1} (equation 6) $1 - f_{PRJ,BRANCH,i,t}$ = the proportion of aboveground live tree biomass remaining after netting out branch biomass, in polygon *i* (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) $1 - f_{PRJ,BUCKINGLOSS,i,t}$ = the proportion of the log bole remaining after processing for quality, in polygon, *i* (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 12) CF = carbon fraction of dry matter (IPCC default value = 0.5).
8.3.4	56c.3	$$SE_y = LE_y \quad (56c.3)$$ where: SE_y = Secondary Effects in year 'y' (tCO_2e) calculated using equations in Figure 1 and equations 56c.1, 56c.2 and 56c.3. LE_Y = Leakage in year y (in tonnes CO_2e yr^{-1}) – used in equation 58.

Methodology Section #	Equation #	Screenshot
8.3.5	56d	For project proponents utilizing Leakage Option 3, project market leakage (LE_Y; t CO_2e yr^{-1}) is calculated as: $$LE_Y = MLF_y \bullet ER_{y,GROSS} \quad (56d)$$ Where, MLF_y = the market leakage factor in year, *y* (as calculate per section 8.3.5) $ER_{y,GROSS}$ = the gross difference in the overall carbon balance between the baseline and project scenarios in year *y* (t CO_2e yr^{-1}). See equation 57 for its calculation.
8.5	57	*Gross* carbon emissions reductions (ER_{y},gross; t CO_2e yr^{-1}) created by the carbon project are calculated annually as the difference between the baseline and project scenario net emission reductions/emissions: $$ER_{y,GROSS} = (\Delta C_{BSL,t} - \Delta C_{PRJ,t}) \bullet 44/12 \quad (57)$$ Where, $\Delta C_{BSL,t}$ = total net baseline scenario emissions calculated from equation 1 (t C yr^{-1}). $\Delta C_{PRJ,t}$ = total net project scenario emissions calculated from equation 29 (t C yr^{-1}). 44/12 = factor to convert C to CO_2e

Methodology Section #	Equation #	Screenshot
8.5.1	58	The annual *net* carbon emissions reductions is the actual net GHG removals by sinks from the project scenario minus the net GHG removals by sinks from the baseline scenario, were then calculated by applying the leakage and uncertainty discount factors (but not the VCS permanence buffer), on an annualized basis: $\mathbf{ER_y = ER_{y,GROSS} - LE_y}$ **(58)** where: ER_y = the net GHG emissions reductions and/or removals in year *y* (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) (t CO_2e yr^{-1}). $ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios (t CO_2e yr^{-1}). LE_y = Leakage in year y (t CO_2e yr^{-1}), as calculated in equation 56b.
8.5.2	59	The number of VCU's the project available for issuance and sale in year, *y* (VCU_y; t CO_2e yr^{-1}), is calculated as: $\mathbf{VCU_y = ER_y \bullet (1 - ER_{y,ERR}) - BR_y}$ **(59)** where: ER_y = the net GHG emissions reductions and/or removals in year (t CO_2e yr^{-1}), as calculated in equation 58. $ER_{y,ERR}$ = the uncertainty factor for year, y, (calculated in Section 8.5.3), expressed as a proportion. BR_y = estimated VCU-equivalent tCO_2e issued to the VCS Buffer Pool in year, *y*, calculated using the latest version of the VCS AFOLU Non-Permanence Risk Tool. BRy is calculated by multiplying the most current verified permanence risk Buffer Withholding Percentage for the project by the change in carbon stocks (difference between baseline and project scenario) for the project area as per the latest approved VCS AFOLU Requirements (Voluntary Carbon Standard, 2008a).

Methodology Section #	Equation #	Screenshot
8.5.3	60a	$E_M = 100 \cdot (\sum y_{d,h,i} / \sum(A_{PRJ,h} \cdot y_{m,h,i}))$ **(60a)** where: The summation is across all plot observations, *i*, and across all analysis units , *h*;
8.5.3	60b	$y_{d,h,i} = A_{PRJ,h} \cdot (y_{m,h,i} - y_{p,h,i})$ **(60b)** E_M = Mean model error for the project (%) $y_{d,h,i}$ = the area-weighted difference between measured and predicted carbon storage in analysis unit, *h*, plot observation, *i* (t C) $y_{m,h,i}$ = carbon storage measured in analysis unit, *h*, plot observation, *i* (t C ha^{-1}) $y_{p,h,i}$ = carbon storage predicted by model for analysis unit , *h*, plot observation, *i* (t C ha^{-1}) $A_{PRJ,h}$ = area of project analysis unit, *h* (ha)
8.5.3	60c	$E_I = 100 \cdot [SE * 1.654 / ((1/N) \cdot \sum(A_{PRJ,h} \cdot y_{m,h,i}))]$ **(60c)** Where, E_I = Inventory error for the project (%) SE = the project level standard error of the area weighted differences between measured plot observation and predicted values of carbon storage. N = total number of plot observations in all analysis units or polygons[37] 1.654 = the 90% confidence interval *t*-value

Methodology Section #	Equation #	Screenshot
		All other terms as defined in equation 60a.
8.5.3	60d	$SE = S/\sqrt{N}$ **(60d)** Where, N = total number of plot observations in all analysis units or polygons (see Footnote 37) S = the standard deviation of the area weighted differences between measured and predicted values of carbon storage across all analysis unit or polygons.
8.5.3	60e	$S = \sqrt{[(1/N-1) \cdot \sum(y_{d,h,i} - \bar{y}bar_d)^2]}$ **(60e)** Where, $\bar{y}bar_d$ = the project-level mean of the area weighted differences between measured plot observation and predicted values of carbon storage. See equation 60b for the calculation of $y_{d,h,i}$ All other terms as defined in equation 60b and 60c.
8.5.3	60f	$E_P = E_M + E_I$ **(60f)**

Methodology Section #	Equation #	Screenshot
9.3.5	61a	Each piece of dead wood will be assigned to one of three density classes, sound (1), intermediate (2), and rotten (3) (details below). The volume per unit area is calculated for each density class, *c*, as: $V_{LDW,c} = \pi^2 * [(d_1^2 + d_2^2 \ldots d_n^2)/8L]$ **(60a)** where: d_1, d_2, d_n = diameter (cm) of each of *n* pieces intersecting the line, and L = the length of the line (100 m default (Harmon, et al., 1986).
9.3.5	61b	The mass of LDW in density class, *c* (t ha^{-1}), is: $M_{LDW,c} = V_{LDW,c} * D_{LDW,c}$ **(60b)** where: $V_{LDW,c}$ = the volume per unit area calculated for each density class, *c*, as calculated in 60a. $D_{LDW,c}$ = the density of LDW in density class, *c* (t d.m. m^{-3})
9.3.5	61c	The total mass of LDW in each plot summed over all density classes (t ha^{-1}) is: $DOM_{LDW} = \sum M_{LDW,c}$ **(60c)** where: $M_{LDW,c}$ = the mass of LDW in density class, *c* (t ha^{-1}), is as calculated in 60b.

APPENDIX 6 – RESULTING VALUES

Year	Time Step	Delta Total Ecosystem (BSL) tC	HWP (BSL) tC (Eq 19)	Emissions (BSL) tC (Eq 24)	Total BSL Emissions tC	Estimated net GHG emission reductions or removals tCO2e	Delta Total Ecosystem (PRJ) tC	HWP (PRJ) tC	Emissions (PRJ) tC	Total PRJ Emissions (tC)	Estimated project emissions or removals tCO2e	MIFy	ERy,gross (Eq 57)	LEy (Eq 56b)	ERy (Eq 58)	ERy - Uncert (@ 1.5%)	Buffer Pool Allocation	VCUy (Eq 59)
01-January-2017 - 31-December-2017	-	-		-	-	-	-	-	-	-	-	-						
01-January-2018 - 31-December-2018	1	(1,032)	-	74	(1,107)	(4,058)	(231)	-	36	(267)	(978)	20%	3,080	616.0	2,464	2,427	345	2,082
01-January-2019 - 31-December-2019	2	(1,106)	20	75	(1,160)	(4,255)	(96)	(965)	29	(1,091)	(4,000)	20%	255	51.1	204	201	29	173
01-January-2020 - 31-December-2020	3	(1,167)	(1)	75	(1,242)	(4,555)	110	(610)	21	(521)	(1,909)	20%	2,646	529.2	2,117	2,085	296	1,789
01-January-2021 - 31-December-2021	4	(1,229)	3	75	(1,301)	(4,770)	(367)	1,869	39	1,463	5,363	20%	10,133	2,026.6	8,106	7,985	1,135	6,850
01-January-2022 - 31-December-2022	5	(1,297)	1	75	(1,371)	(5,028)	634	(3,995)	-	(3,361)	(12,322)	20%	(7,294)	(1,458.8)	(5,835)	(5,748)	(817)	(4,931)
01-January-2023 - 31-December-2023	6	(1,363)	(34)	75	(1,471)	(5,395)	752	-	-	752	2,758	20%	8,154	1,630.7	6,523	6,425	913	5,512
01-January-2024 - 31-December-2024	7	(1,403)	(133)	74	(1,610)	(5,902)	856	-	-	856	3,137	20%	9,039	1,807.8	7,231	7,123	1,012	6,110
01-January-2025 - 31-December-2025	8	(1,419)	(146)	72	(1,637)	(6,003)	926	-	-	926	3,395	20%	9,397	1,879.5	7,518	7,405	1,053	6,353
01-January-2026 - 31-December-2026	9	(1,402)	(213)	70	(1,685)	(6,177)	631	1,372	14	1,989	7,294	20%	13,471	2,694.2	10,777	10,615	1,509	9,106
01-January-2027 - 31-December-2027	10	(1,419)	(99)	69	(1,586)	(5,815)	644	(1)	14	629	2,307	20%	8,122	1,624.3	6,497	6,400	910	5,490
01-January-2028 - 31-December-2028	11	(1,401)	(148)	67	(1,616)	(5,924)	667	(0)	14	653	2,393	20%	8,318	1,663.5	6,654	6,554	932	5,623
01-January-2029 - 31-December-2029	12	(1,387)	(118)	66	(1,571)	(5,760)	685	1	14	672	2,465	20%	8,225	1,645.0	6,580	6,481	921	5,560
01-January-2030 - 31-December-2030	13	(1,380)	(90)	65	(1,534)	(5,626)	692	(1)	14	677	2,482	20%	8,108	1,621.6	6,486	6,389	908	5,481
01-January-2031 - 31-December-2031	14	(1,374)	(88)	64	(1,526)	(5,595)	700	3	14	689	2,527	20%	8,122	1,624.3	6,497	6,400	910	5,490
01-January-2032 - 31-December-2032	15	(1,404)	80	65	(1,389)	(5,091)	704	(3)	14	687	2,520	20%	7,611	1,522.2	6,089	5,997	852	5,145
01-January-2033 - 31-December-2033	16	(1,383)	(126)	63	(1,572)	(5,766)	707	1	14	694	2,546	20%	8,312	1,662.4	6,650	6,550	931	5,619
01-January-2034 - 31-December-2034	17	(1,367)	(108)	62	(1,537)	(5,636)	705	1	14	692	2,539	20%	8,174	1,634.8	6,539	6,441	915	5,526
01-January-2035 - 31-December-2035	18	(1,352)	(128)	61	(1,541)	(5,651)	707	(0)	14	693	2,541	20%	8,192	1,638.4	6,554	6,455	917	5,538
01-January-2036 - 31-December-2036	19	(1,273)	(289)	58	(1,620)	(5,939)	707	2	14	695	2,549	20%	8,488	1,697.6	6,790	6,688	951	5,738
01-January-2037 - 31-December-2037	20	(1,327)	258	60	(1,129)	(4,140)	702	1	14	689	2,526	20%	6,666	1,333.3	5,333	5,253	747	4,506
01-January-2038 - 31-December-2038	21	(1,299)	(209)	58	(1,566)	(5,743)	685	1	14	673	2,467	20%	8,209	1,641.9	6,568	6,469	919	5,550
01-January-2039 - 31-December-2039	22	(1,257)	(143)	57	(1,457)	(5,342)	683	(2)	14	668	2,449	20%	7,790	1,558.1	6,232	6,139	873	5,266
01-January-2040 - 31-December-2040	23	(1,243)	(32)	56	(1,332)	(4,882)	671	1	14	658	2,414	20%	7,296	1,459.3	5,837	5,749	817	4,932
01-January-2041 - 31-December-2041	24	(1,200)	(137)	55	(1,391)	(5,101)	662	(1)	14	647	2,373	20%	7,474	1,494.8	5,979	5,890	837	5,052
01-January-2042 - 31-December-2042	25	(1,299)	294	58	(1,064)	(3,900)	628	(1)	14	614	2,250	20%	6,150	1,230.0	4,920	4,846	689	4,157
01-January-2043 - 31-December-2043	26	(1,253)	(146)	56	(1,455)	(5,337)	629	0	14	616	2,258	20%	7,594	1,518.9	6,075	5,984	851	5,134
01-January-2044 - 31-December-2044	27	(1,469)	773	65	(762)	(2,792)	620	1	14	608	2,228	20%	5,021	1,004.1	4,017	3,956	562	3,394
01-January-2045 - 31-December-2045	28	(1,471)	(91)	64	(1,626)	(5,962)	615	0	14	602	2,206	20%	8,167	1,633.5	6,534	6,436	915	5,521
01-January-2046 - 31-December-2046	29	(1,425)	(203)	62	(1,689)	(6,194)	618	1	14	605	2,219	20%	8,413	1,682.7	6,731	6,630	942	5,687
01-January-2047 - 31-December-2047	30	(1,386)	(181)	60	(1,626)	(5,962)	611	(1)	14	597	2,189	20%	8,150	1,630.0	6,520	6,422	913	5,510
												Total Est. GHG	211,484		169,187	166,649	23,686	142,963
												Aver. Est. GHG	7,049					4,765

APPENDIX 7 – SCOPE 3 EMISSIONS NOTIFICATION

https://www.graf-von-westphalen.de/news/kundeninformation-scope-3-emissionen/

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Updates

Central Administration

Locations Forestry

- *Forestry Bureau*
- *Bannenberg district*
- *Area Buchenberg*
- *Revier Glashütte*
- *Area Hassel*
- *Herbram area*
- *Millet area*
- *Revier Laer*
- *Revier Rixdorf*

Locations Agriculture

- *Gut Böken*
- *Dinkelburg Manor*
- *Fürstenberg Manor*
- *Gut Laer*
- *Gut Rixdorf*

Customer information on Scope 3 emissions

Dear customers,

Matthias Graf von Westphalen is carrying out a forest carbon project according to the globally recognized VERRA Verified Carbon Standard (VCS) to help reduce and eliminate greenhouse gas emissions.

This is done by reducing the amount of regular timber to approx. 775 ha of our forest area in the federal states of Schleswig-Holstein, Thuringia, North Rhine-Westphalia and Lower Saxony.

For forest protection and risk mitigation measures, there will continue to be little forest management activity.

As a supplier of logs to various supply chains of companies, we would like to inform you that we are claiming the "transport emissions" for logs transported from our forest areas to our customers' plants and production facilities as part of the carbon project. These are referred to as "Scope 3 emissions", the purpose of this declaration is to avoid the risk of double counting emissions along the supply chain.

For more information, please contact us at

@ forstamt@graf-von-westphalen.de

or visit our website www.graf-von-westphalen.de/wald

If you would like more information about VERRA or Scope 3 emissions, please use the following links:

VERRA
https://verra.org/about/overview/

Greenhouse Gas Protocol Scope 3

https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf

Yours sincerely,

signed Dr. Johannes Gerst

Forest Operations Manager

Startseite | Kontakt | Aktuelles | Stellenangebote | Sitemap | Impressum | Datenschutz

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Graf von Westphalen

Wald | Feld | Flur | Unternehmen | Wir vor Ort | Kontakt Service |

Centralverwaltung

Standorte Forstwirtschaft

- *Forstamt*
- *Revier Bannenberg*
- *Revier Buchenberg*
- *Revier Glashütte*
- *Revier Hassel*
- *Revier Herbram*
- *Revier Hirse*
- *Revier Laer*
- *Revier Rixdorf*

Standorte Landwirtschaft

- *Gut Böken*
- *Gut Dinkelburg*
- *Gut Fürstenberg*
- *Gut Laer*
- *Gut Rixdorf*

Kundeninformation Scope-3-Emissionen

Liebe Kundinnen, liebe Kunden,

Matthias Graf von Westphalen führt ein Waldkohlenstoffprojekt nach dem weltweit anerkannten VERRA Verified Carbon Standard (VCS) durch, um dazu beizutragen, Treibhausgasemissionen zu reduzieren und zu beseitigen.

Dies geschieht durch die Reduzierung des Regelholzeinschlags auf ca. 775 ha unserer Waldfläche in den Bundesländern Schleswig-Holstein, Thüringen, Nordrhein-Westfalen und Niedersachsen.

Für Forstschutz- und Risikominderungsmaßnahmen wird es weiterhin zu geringen forstbetrieblichen Aktivitäten kommen.

Als Rundholzlieferant für verschiedene Lieferketten von Unternehmen möchten wir Sie darüber informieren, dass wir dabei die „Transportemissionen" für Rundholz geltend machen, das von unseren Waldflächen im Rahmen des Kohlenstoffprojekts zu den Werken und Produktionsstätten unserer Kunden transportiert wurde. Diese werden als „Scope-3-Emissionen" bezeichnet, Zweck dieser Erklärung ist es, das Risiko einer Doppelzählung von Emissionen entlang der Lieferkette zu vermeiden.

Für weitere Informationen kontaktieren Sie uns gerne unter

@ forstamt@graf-von-westphalen.de

oder besuchen Sie unsere Website www.graf-von-westphalen.de/wald

Wenn Sie weitere Informationen zu VERRA oder zu Scope-3-Emissionen wünschen, verwenden Sie bitte die folgenden Links:

VERRA
https://verra.org/about/overview/

Greenhouse Gas Protocol Scope 3

https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf

Mit freundlichen Grüßen

gez. Dr. Johannes Gerst

Forstbetriebsleiter

APPENDIX 8 – PROJECT AREA POLYGONS

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Bannenberg	Westphalen	51.5174	9.3008	00940606-0636-C-H010
Bannenberg	Westphalen	51.5167	9.2968	00940606-0637-A-H010
Bannenberg	Westphalen	51.5163	9.2925	00940606-0637-B-H010
Bannenberg	Westphalen	51.5159	9.2944	00940606-0637-B-H040
Bannenberg	Westphalen	51.5152	9.2893	00940606-0638-B-H020
Bannenberg	Westphalen	51.5147	9.2912	00940606-0638-B-H010
Bannenberg	Westphalen	51.5147	9.2977	00940606-0638-A-H020
Bannenberg	Westphalen	51.5148	9.2926	00940606-0638-B-H070
Bannenberg	Westphalen	51.5130	9.2769	00940606-0633-A-H030
Bannenberg	Westphalen	51.5153	9.2946	00940606-0638-B-H040
Bannenberg	Westphalen	51.5153	9.2952	00940606-0638-B-H050
Bannenberg	Westphalen	51.5131	9.3058	00940606-0634-A-H030
Bannenberg	Westphalen	51.5130	9.2764	00940606-0633-A-H020
Bannenberg	Westphalen	51.5127	9.2785	00940606-0633-A-H010
Bannenberg	Westphalen	51.5155	9.2982	00940606-0638-A-H010
Bannenberg	Westphalen	51.5192	9.3048	00940606-0635-B-H020
Bannenberg	Westphalen	51.5176	9.3065	00940606-0635-A-H010
Bannenberg	Westphalen	51.5183	9.2999	00940606-0636-C-H020
Bannenberg	Westphalen	51.5178	9.3033	00940606-0636-B-H010
Bannenberg	Westphalen	51.5169	9.2962	00940606-0637-A-H020
Bannenberg	Westphalen	51.5174	9.2991	00940606-0636-C-H030
Bannenberg	Westphalen	51.5159	9.3017	00940606-0636-A-H010
Bannenberg	Westphalen	51.5168	9.2908	00940606-0637-B-H030
Bannenberg	Westphalen	51.5153	9.2805	00940606-0639-B-H010
Bannenberg	Westphalen	51.5151	9.2845	00940606-0639-A-H010
Bannenberg	Westphalen	51.5151	9.2934	00940606-0638-B-H030
Bannenberg	Westphalen	51.5145	9.3054	00940606-0634-B-H010
Bannenberg	Westphalen	51.5139	9.2794	00940606-0633-B-H010
Bannenberg	Westphalen	51.5129	9.3048	00940606-0634-A-H020
Bannenberg	Westphalen	51.5188	9.3061	00940606-0635-B-H010
Bannenberg	Westphalen	51.5173	9.3047	00940606-0636-A-H030
Bannenberg	Westphalen	51.5172	9.3040	00940606-0636-A-H020
Bannenberg	Westphalen	51.5166	9.2912	00940606-0637-B-H020
Bannenberg	Westphalen	51.5164	9.2984	00940606-0638-A-H030
Bannenberg	Westphalen	51.5158	9.3048	00940606-0635-A-H020
Bannenberg	Westphalen	51.5144	9.3033	00940606-0634-C-H010

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Bannenberg	Westphalen	51.5132	9.3035	00940606-0634-A-H010
Bannenberg	Westphalen	51.5161	9.2910	00940606-0637-B-H050
Bannenberg	Westphalen	51.5154	9.2857	00940606-0639-A-H020
Bannenberg	Westphalen	51.5144	9.2916	00940606-0638-B-H060
Glashütte	Westphalen	51.4652	8.7688	00940101-0137-C-H010
Glashütte	Westphalen	51.4799	8.7952	00940101-0112-C-H010
Glashütte	Westphalen	51.4843	8.8125	00940101-0114-C-H050
Glashütte	Westphalen	51.4815	8.7990	00940101-0116-A-H010
Glashütte	Westphalen	51.4871	8.7870	00940101-0118-D-H010
Glashütte	Westphalen	51.4874	8.7873	00940101-0118-D-H020
Glashütte	Westphalen	51.4574	8.7875	00940101-0122-D-H010
Glashütte	Westphalen	51.4607	8.7862	00940101-0122-I-H030
Glashütte	Westphalen	51.4645	8.7758	00940101-0132-E-H020
Glashütte	Westphalen	51.4647	8.7731	00940101-0136-A-H050
Glashütte	Westphalen	51.4880	8.7815	00940101-0155-D-H010
Glashütte	Westphalen	51.4898	8.7750	00940101-0155-E-H020
Glashütte	Westphalen	51.4798	8.7983	00940101-0111-C-H010
Glashütte	Westphalen	51.4799	8.7933	00940101-0112-C-H020
Glashütte	Westphalen	51.4592	8.7895	00940101-0122-A-H050
Glashütte	Westphalen	51.4601	8.7881	00940101-0122-B-H010
Glashütte	Westphalen	51.4584	8.7873	00940101-0122-C-H010
Glashütte	Westphalen	51.4562	8.7822	00940101-0123-A-H010
Glashütte	Westphalen	51.4571	8.7772	00940101-0123-B-H030
Glashütte	Westphalen	51.4569	8.7741	00940101-0125-D-H010
Glashütte	Westphalen	51.4640	8.7852	00940101-0132-H-H010
Glashütte	Westphalen	51.4612	8.7819	00940101-0122-H-H010
Glashütte	Westphalen	51.4725	8.7959	00940101-0130-B-H010
Glashütte	Westphalen	51.4722	8.7926	00940101-0130-C-H010
Glashütte	Westphalen	51.4717	8.7988	00940101-0130-D-H010
Glashütte	Westphalen	51.4657	8.7837	00940101-0131-E-H010
Glashütte	Westphalen	51.4651	8.7840	00940101-0132-A-H020
Glashütte	Westphalen	51.4627	8.7774	00940101-0133-A-H040
Glashütte	Westphalen	51.4584	8.7707	00940101-0134-A-H010
Glashütte	Westphalen	51.4616	8.7696	00940101-0136-A-H020
Glashütte	Westphalen	51.4698	8.7790	00940101-0142-B-H010
Glashütte	Westphalen	51.4747	8.7775	00940101-0142-E-H010
Glashütte	Westphalen	51.4725	8.7724	00940101-0143-B-H010
Glashütte	Westphalen	51.4663	8.7656	00940101-0146-D-H010
Glashütte	Westphalen	51.4682	8.7643	00940101-0148-B-H020
Glashütte	Westphalen	51.4764	8.7767	00940101-0151-A-H010
Glashütte	Westphalen	51.4721	8.7614	00940101-0148-E-H010

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Glashütte	Westphalen	51.4719	8.7504	00940101-0162-C-H010
Hassel	Westphalen	51.4965	8.7569	00940202-0208-B-H010
Hassel	Westphalen	51.4949	8.7580	00940202-0208-A-H010
Hassel	Westphalen	51.5006	8.7263	00940202-0213-A-H010
Hassel	Westphalen	51.4815	8.7595	00940202-0290-D-H020
Hassel	Westphalen	51.4994	8.7309	00940202-0212-A-H010
Hassel	Westphalen	51.4966	8.7538	00940202-0209-D-H010
Hassel	Westphalen	51.4938	8.7560	00940202-0209-A-H010
Hassel	Westphalen	51.4941	8.7611	00940202-0299-E-H010
Hassel	Westphalen	51.4801	8.7645	00940202-0258-A-H020
Hassel	Westphalen	51.4795	8.7738	00940202-0257-B-H030
Hassel	Westphalen	51.4848	8.7662	00940202-0289-B-H060
Hassel	Westphalen	51.4806	8.7610	00940202-0290-D-H010
Hassel	Westphalen	51.4932	8.7623	00940202-0299-E-H020
Hassel	Westphalen	51.4789	8.7629	00940202-0258-C-H010
Hassel	Westphalen	51.4793	8.7748	00940202-0257-A-H010
Hassel	Westphalen	51.4870	8.7709	00940202-0289-A-H010
Herbram	Westphalen	51.6442	8.8637	00940404-0470-B-H020
Herbram	Westphalen	51.6851	8.8845	00940404-0453-A-H010
Herbram	Westphalen	51.6752	8.9517	00940404-0410-A-H010
Herbram	Westphalen	51.6733	8.9451	00940404-0407-A-H010
Herbram	Westphalen	51.6658	8.9209	00940404-0403-A-H010
Herbram	Westphalen	51.6740	8.9493	00940404-0407-C-H010
Herbram	Westphalen	51.6947	8.9031	00940404-0437-A-H010
Herbram	Westphalen	51.6921	8.8978	00940404-0438-A-H010
Herbram	Westphalen	51.6941	8.9084	00940404-0436-A-H010
Herbram	Westphalen	51.6917	8.8927	00940404-0439-B-H010
Herbram	Westphalen	51.6869	8.8982	00940404-0444-C-H010
Herbram	Westphalen	51.6791	8.9250	00940404-0429-A-H020
Herbram	Westphalen	51.6611	8.9150	00940404-0404-A-H010
Herbram	Westphalen	51.6424	8.8614	00940404-0470-B-H010
Herbram	Westphalen	51.6406	8.8550	00940404-0471-A-H010
Herbram	Westphalen	51.6822	8.9267	00940404-0429-B-H010
Herbram	Westphalen	51.6941	8.8951	00940404-0442-A-H010
Herbram	Westphalen	51.6877	8.9001	00940404-0443-B-H010
Herbram	Westphalen	51.6883	8.9022	00940404-0432-B-H020
Herbram	Westphalen	51.6604	8.8614	00940404-0482-B-H010
Herbram	Westphalen	51.6602	8.8636	00940404-0482-A-H010
Herbram	Westphalen	51.6568	8.8630	00940404-0481-A-H010
Herbram	Westphalen	51.6567	8.8714	00940404-0480-B-H010
Herbram	Westphalen	51.6569	8.8701	00940404-0480-A-H020

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Herbram	Westphalen	51.6548	8.8553	00940404-0477-B-H010
Herbram	Westphalen	51.6543	8.8565	00940404-0477-A-H010
Herbram	Westphalen	51.6535	8.8583	00940404-0476-A-H010
Herbram	Westphalen	51.6538	8.8601	00940404-0476-A-H020
Herbram	Westphalen	51.6530	8.8598	00940404-0476-A-H030
Herbram	Westphalen	51.6519	8.8525	00940404-0475-A-H030
Herbram	Westphalen	51.6505	8.8541	00940404-0475-A-H010
Herbram	Westphalen	51.6501	8.8540	00940404-0475-B-H010
Herbram	Westphalen	51.6462	8.8523	00940404-0474-A-H010
Herbram	Westphalen	51.6460	8.8534	00940404-0474-A-H020
Herbram	Westphalen	51.6447	8.8658	00940404-0470-A-H010
Herbram	Westphalen	51.6428	8.8506	00940404-0472-B-H010
Herbram	Westphalen	51.6439	8.8524	00940404-0472-B-H020
Herbram	Westphalen	51.6437	8.8661	00940404-0470-A-H020
Herbram	Westphalen	51.6436	8.8612	00940404-0470-C-H010
Herbram	Westphalen	51.6415	8.8620	00940404-0470-B-H030
Herbram	Westphalen	51.6405	8.8495	00940404-0472-A-H010
Herbram	Westphalen	51.6808	8.9239	00940404-0429-A-H010
Herbram	Westphalen	51.6614	8.8654	00940404-0480-C-H010
Herbram	Westphalen	51.6573	8.8678	00940404-0480-A-H010
Herbram	Westphalen	51.6560	8.8714	00940404-0480-B-H020
Herbram	Westphalen	51.6535	8.8681	00940404-0478-A-H010
Herbram	Westphalen	51.6546	8.8625	00940404-0479-A-H010
Herbram	Westphalen	51.6539	8.8648	00940404-0479-A-H020
Herbram	Westphalen	51.6504	8.8555	00940404-0475-A-H020
Herbram	Westphalen	51.6469	8.8596	00940404-0473-A-H010
Herbram	Westphalen	51.6419	8.8559	00940404-0470-D-H010
Herbram	Westphalen	51.6414	8.8556	00940404-0471-A-H030
Herbram	Westphalen	51.6400	8.8522	00940404-0471-A-H020
Hirse	Westphalen	51.5029	8.8254	00940303-0301-A-H010
Hirse	Westphalen	51.4868	8.8164	00940303-0361-E-H010
Hirse	Westphalen	51.5275	8.7295	00940303-0316-I-H010
Hirse	Westphalen	51.5249	8.7191	00940303-0316-E-H090
Hirse	Westphalen	51.5202	8.7240	00940303-0316-D-H010
Laer	Westphalen	51.3621	8.2271	00940505-0531-E-H010
Laer	Westphalen	51.3610	8.2311	00940505-0531-C-H010
Laer	Westphalen	51.3499	8.2547	00940505-0527-E-H030
Laer	Westphalen	51.3622	8.2344	00940505-0530-A-H030
Laer	Westphalen	51.3615	8.2352	00940505-0530-A-H020
Laer	Westphalen	51.3600	8.2315	00940505-0531-B-H010
Laer	Westphalen	51.3592	8.2296	00940505-0531-B-H020

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Laer	Westphalen	51.3533	8.2657	00940505-0527-C-H010
Laer	Westphalen	51.3514	8.2572	00940505-0527-D-H010
Laer	Westphalen	51.3326	8.2315	00940505-0517-B-H010
Laer	Westphalen	51.3586	8.2290	00940505-0531-A-H010
Laer	Westphalen	51.3632	8.2365	00940505-0530-A-H010
Laer	Westphalen	51.3594	8.2649	00940505-0527-H-H010
Laer	Westphalen	51.3522	8.2611	00940505-0527-B-H020
Laer	Westphalen	51.3510	8.2537	00940505-0527-F-H010
Laer	Westphalen	51.3508	8.2587	00940505-0527-B-H010
Laer	Westphalen	51.3483	8.2393	00940505-0524-B-H020
Laer	Westphalen	51.3461	8.2490	00940505-0522-D-H010
Laer	Westphalen	51.3478	8.2424	00940505-0524-B-H010
Laer	Westphalen	51.3598	8.2278	00940505-0531-E-H040
Laer	Westphalen	51.3591	8.2274	00940505-0531-E-H020
Laer	Westphalen	51.3584	8.2275	00940505-0531-E-H030
Laer	Westphalen	51.3517	8.2637	00940505-0527-A-H010
Laer	Westphalen	51.3520	8.2506	00940505-0527-G-H010
Laer	Westphalen	51.3518	8.2676	00940505-0527-A-H030
Laer	Westphalen	51.3513	8.2546	00940505-0527-B-H030
Laer	Westphalen	51.3512	8.2558	00940505-0527-B-H050
Laer	Westphalen	51.3503	8.2547	00940505-0527-E-H020
Laer	Westphalen	51.3496	8.2564	00940505-0527-E-H010
Laer	Westphalen	51.3902	8.2013	00940505-0538-D-H010
Laer	Westphalen	51.3606	8.2281	00940505-0531-D-H010
Laer	Westphalen	51.3527	8.2640	00940505-0527-A-H020
Laer	Westphalen	51.3501	8.2431	00940505-0525-A-H010
Laer	Westphalen	51.3509	8.2553	00940505-0527-B-H040
Laer	Westphalen	51.3479	8.2463	00940505-0524-A-H010
Laer	Westphalen	51.3363	8.2491	00940505-0516-D-H010
Laer	Westphalen	51.3483	8.2504	00940505-0526-A-H010
Rixdorf	Westphalen	54.1809	10.4533	00940707-0702-B-H020
Rixdorf	Westphalen	54.2165	10.4021	00940707-0725-H-H010
Rixdorf	Westphalen	54.0650	10.4114	00940707-0862-A-H010
Rixdorf	Westphalen	54.1798	10.4500	00940707-0701-C-H010
Rixdorf	Westphalen	54.2158	10.3957	00940707-0725-G-H010
Rixdorf	Westphalen	54.3281	10.2266	00940707-0765-A-H020
Rixdorf	Westphalen	54.0508	10.3505	00940707-0837-D-H010
Rixdorf	Westphalen	54.1948	10.3971	00940707-0707-B-H010
Rixdorf	Westphalen	54.2043	10.4127	00940707-0725-D-H010
Rixdorf	Westphalen	54.2304	10.4825	00940707-0750-A-H050
Rixdorf	Westphalen	54.2001	10.4398	00940707-0708-H-H020

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Rixdorf	Westphalen	54.2083	10.4178	00940707-0725-C-H010
Rixdorf	Westphalen	54.2526	10.4278	00940707-0738-A-H010
Rixdorf	Westphalen	54.0622	10.3974	00940707-0855-G-H010
Rixdorf	Westphalen	54.1810	10.4591	00940707-0702-G-H020
Rixdorf	Westphalen	54.1775	10.4384	00940707-0703-B-H020
Rixdorf	Westphalen	54.1944	10.4322	00940707-0708-E-H010
Rixdorf	Westphalen	54.1994	10.4424	00940707-0708-H-H010
Rixdorf	Westphalen	54.2069	10.4602	00940707-0710-A-H040
Rixdorf	Westphalen	54.2190	10.4677	00940707-0721-C-H030
Rixdorf	Westphalen	54.2178	10.4647	00940707-0722-B-H010
Rixdorf	Westphalen	54.2200	10.4640	00940707-0722-E-H010
Rixdorf	Westphalen	54.2204	10.4611	00940707-0722-F-H020
Rixdorf	Westphalen	54.2327	10.4279	00940707-0727-D-H020
Rixdorf	Westphalen	54.2138	10.4998	00940707-0743-B-H030
Rixdorf	Westphalen	54.2298	10.4846	00940707-0750-A-H020
Rixdorf	Westphalen	54.3284	10.2264	00940707-0765-A-H030
Rixdorf	Westphalen	54.0415	10.4888	00940707-0809-B-H010
Rixdorf	Westphalen	54.0515	10.3503	00940707-0837-D-H020
Rixdorf	Westphalen	54.0646	10.3485	00940707-0843-A-H010
Rixdorf	Westphalen	54.0654	10.4141	00940707-0861-B-H030
Rixdorf	Westphalen	54.0669	10.4148	00940707-0861-D-H010
Rixdorf	Westphalen	54.1841	10.4522	00940707-0702-E-H010
Rixdorf	Westphalen	54.1850	10.4528	00940707-0702-F-H020
Rixdorf	Westphalen	54.1808	10.4595	00940707-0702-G-H060
Rixdorf	Westphalen	54.1785	10.4444	00940707-0703-A-H060
Rixdorf	Westphalen	54.1811	10.4387	00940707-0704-D-H010
Rixdorf	Westphalen	54.1904	10.4002	00940707-0707-A-H020
Rixdorf	Westphalen	54.1950	10.4395	00940707-0708-B-H010
Rixdorf	Westphalen	54.2129	10.4721	00940707-0712-A-H010
Rixdorf	Westphalen	54.2112	10.4691	00940707-0713-B-H010
Rixdorf	Westphalen	54.2104	10.4675	00940707-0713-B-H020
Rixdorf	Westphalen	54.2165	10.4708	00940707-0716-A-H010
Rixdorf	Westphalen	54.2195	10.4633	00940707-0722-E-H020
Rixdorf	Westphalen	54.2215	10.4621	00940707-0722-G-H010
Rixdorf	Westphalen	54.2082	10.4213	00940707-0725-C-H020
Rixdorf	Westphalen	54.2121	10.4031	00940707-0725-F-H010
Rixdorf	Westphalen	54.2357	10.4259	00940707-0727-B-H010
Rixdorf	Westphalen	54.2416	10.4502	00940707-0728-C-H010
Rixdorf	Westphalen	54.2555	10.4533	00940707-0734-A-H030
Rixdorf	Westphalen	54.2120	10.4970	00940707-0741-B-H030
Rixdorf	Westphalen	54.2299	10.4835	00940707-0750-A-H030

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Rixdorf	Westphalen	54.2310	10.4837	00940707-0750-A-H060
Rixdorf	Westphalen	54.0445	10.4942	00940707-0811-A-H020
Rixdorf	Westphalen	54.0458	10.4911	00940707-0812-B-H010
Rixdorf	Westphalen	54.0443	10.4906	00940707-0813-B-H020
Rixdorf	Westphalen	54.0462	10.4900	00940707-0815-C-H010
Rixdorf	Westphalen	54.0467	10.4877	00940707-0815-D-H010
Rixdorf	Westphalen	54.0467	10.4844	00940707-0815-E-H020
Rixdorf	Westphalen	54.0277	10.4301	00940707-0820-A-H020
Rixdorf	Westphalen	54.0287	10.4305	00940707-0820-B-H010
Rixdorf	Westphalen	54.0471	10.3426	00940707-0836-F-H010
Rixdorf	Westphalen	54.0510	10.3476	00940707-0837-E-H010
Rixdorf	Westphalen	54.0593	10.4163	00940707-0854-B-H030
Rixdorf	Westphalen	54.0605	10.4150	00940707-0856-B-H010
Rixdorf	Westphalen	54.0624	10.4169	00940707-0856-D-H020
Rixdorf	Westphalen	54.0646	10.4114	00940707-0862-A-H050
Rixdorf	Westphalen	54.0673	10.4123	00940707-0862-B-H010
Rixdorf	Westphalen	54.0656	10.4071	00940707-0862-E-H020
Rixdorf	Westphalen	54.3062	10.2296	00940707-0761-C-H010
Rixdorf	Westphalen	54.1812	10.4531	00940707-0702-B-H030
Rixdorf	Westphalen	54.1831	10.4567	00940707-0702-D-H020
Rixdorf	Westphalen	54.1958	10.4395	00940707-0708-B-H020
Rixdorf	Westphalen	54.2054	10.4573	00940707-0709-D-H040
Rixdorf	Westphalen	54.2204	10.4690	00940707-0721-A-H010
Rixdorf	Westphalen	54.2298	10.4562	00940707-0728-A-H020
Rixdorf	Westphalen	54.2476	10.4585	00940707-0729-A-H020
Rixdorf	Westphalen	54.2509	10.4616	00940707-0731-A-H010
Rixdorf	Westphalen	54.2136	10.4973	00940707-0743-B-H040
Rixdorf	Westphalen	54.2373	10.4931	00940707-0751-A-H010
Rixdorf	Westphalen	54.0288	10.4731	00940707-0804-B-H010
Rixdorf	Westphalen	54.0288	10.4706	00940707-0804-D-H010
Rixdorf	Westphalen	54.0417	10.4934	00940707-0805-B-H010
Rixdorf	Westphalen	54.0396	10.4895	00940707-0806-B-H010
Rixdorf	Westphalen	54.0372	10.4848	00940707-0807-B-H010
Rixdorf	Westphalen	54.0419	10.4888	00940707-0809-B-H030
Rixdorf	Westphalen	54.0410	10.4873	00940707-0809-C-H030
Rixdorf	Westphalen	54.0451	10.4912	00940707-0812-A-H010
Rixdorf	Westphalen	54.0464	10.4915	00940707-0812-C-H010
Rixdorf	Westphalen	54.0454	10.4888	00940707-0815-A-H010
Rixdorf	Westphalen	54.0458	10.4862	00940707-0815-B-H010
Rixdorf	Westphalen	54.0473	10.4824	00940707-0815-E-H030
Rixdorf	Westphalen	54.0498	10.4856	00940707-0815-G-H010

Forest Plan	Ownership.	Latitude	Longitude	GIS_ID
Rixdorf	Westphalen	54.0512	10.4830	00940707-0816-A-H020
Rixdorf	Westphalen	54.0261	10.4275	00940707-0819-A-H010
Rixdorf	Westphalen	54.0283	10.4295	00940707-0820-B-H020
Rixdorf	Westphalen	54.0441	10.3442	00940707-0836-B-H010
Rixdorf	Westphalen	54.0470	10.3483	00940707-0837-A-H010
Rixdorf	Westphalen	54.0654	10.3493	00940707-0843-B-H010
Rixdorf	Westphalen	54.0520	10.4338	00940707-0845-A-H010
Rixdorf	Westphalen	54.0518	10.4482	00940707-0845-B-H010
Rixdorf	Westphalen	54.0546	10.4183	00940707-0852-B-H010
Rixdorf	Westphalen	54.0538	10.4204	00940707-0852-B-H020
Rixdorf	Westphalen	54.0574	10.4144	00940707-0853-A-H010
Rixdorf	Westphalen	54.0570	10.4126	00940707-0853-A-H020
Rixdorf	Westphalen	54.0598	10.4025	00940707-0855-A-H010
Rixdorf	Westphalen	54.0628	10.4143	00940707-0856-D-H010
Rixdorf	Westphalen	54.0653	10.4148	00940707-0861-B-H010
Rixdorf	Westphalen	54.0654	10.4131	00940707-0862-A-H020
Rixdorf	Westphalen	54.0667	10.4094	00940707-0862-C-H010
Rixdorf	Westphalen	54.0658	10.4120	00940707-0862-D-H010
Rixdorf	Westphalen	54.0656	10.4087	00940707-0862-E-H010
Rixdorf	Westphalen	54.0696	10.4181	00940707-0863-A-H010

APPENDIX 9 – PEATLANDS MAP

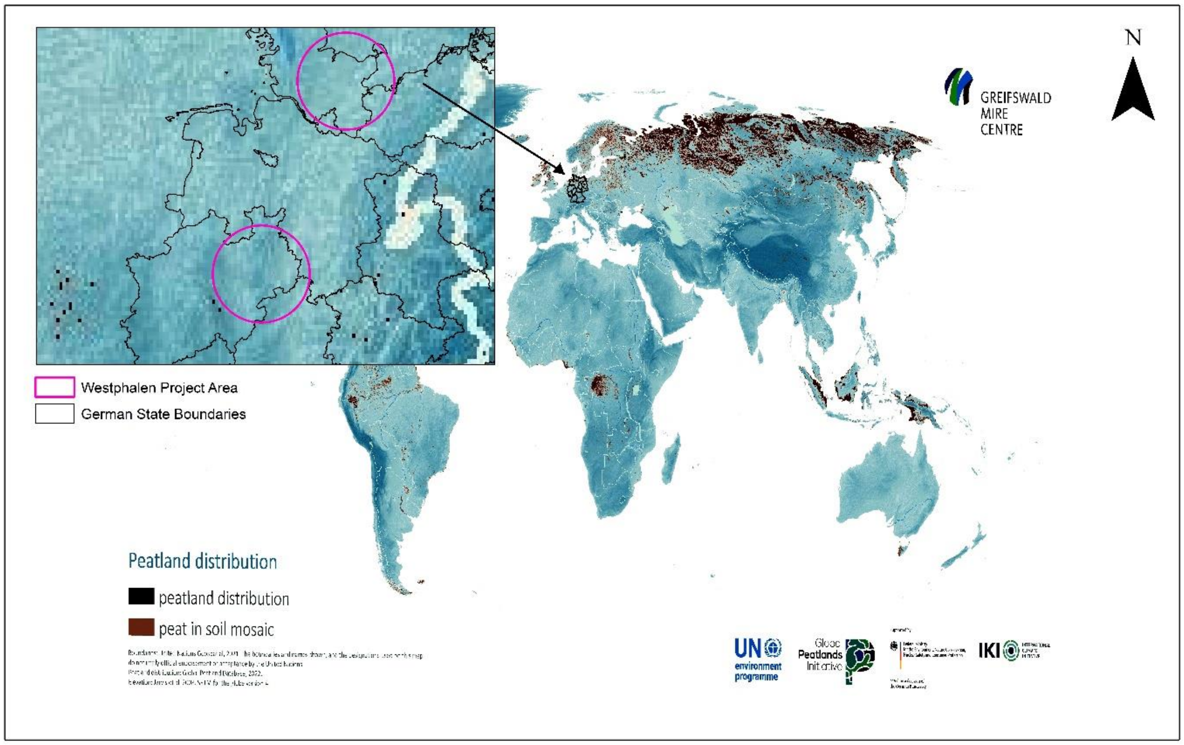

Figure 14: Westphalen Project Area Peatlands Map

APPENDIX 10 – TEMPERATE ZONE MAP

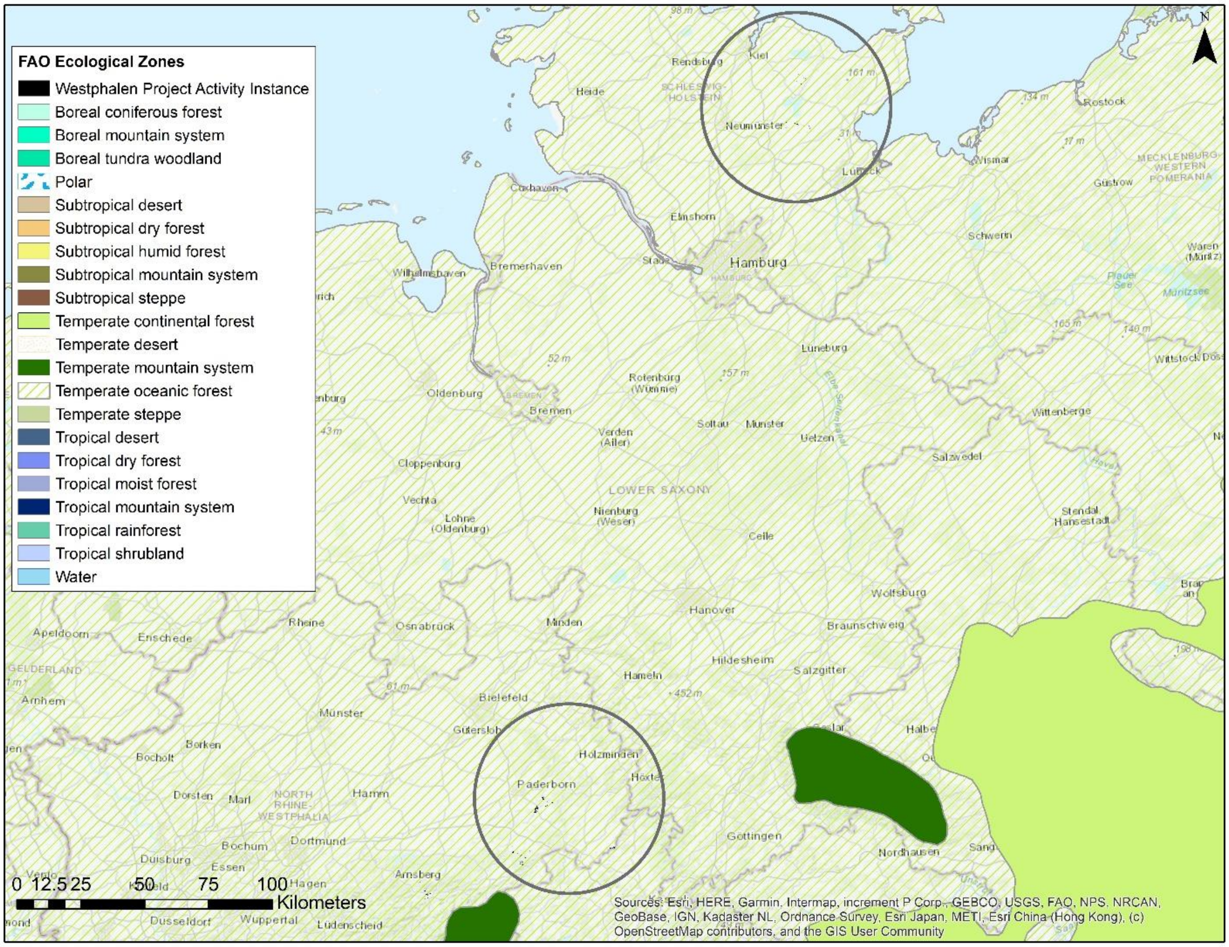

Figure 15: Westphalen Carbon Project Area and FAO Ecological Zones

APPENDIX 11- MARKETZ TOOL: AN INDEPENDENT ASSESSMENT OF THE RISKS OF MARKET LEAKAGE FROM AFOLU-IFM PROJECTS

11.1 Introduction and Scope

As defined within the VSC Methodology VM0012, "market leakage risks occur when a project significantly reduces the production of a commodity causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply". The Market Affects and Risks (MARketz) Tool sets out to accurately, quantitatively, and conservatively assess the risks that Agriculture, Forestry and Other Land Use (AFOLU) carbon projects have on the market equilibrium within the project country.

The MARketz Tool was developed to be applied to projects following the VCS VM0010 and VM00012 methodologies, however, has the potential to be applied to other Improved Forest Management (IFM) project methodologies. The tool itself has been independently developed by resource professionals (Registered Professional Biologists and Professional Foresters) within the province of British Columbia, Canada, and relies on sources and assessments that have been developed by academic/ subject matter experts and are peer reviewed. All references can be found within the *References* section, or as indicated within the footnotes throughout this document.

The intention of the MARketz Tool is to provide an accurate assessment of the potential risks that AFOLU IFM projects pose to the wood products markets where they exist compared to the options currently provided within the Verra VCS Standard. As a methodology deviation it strives to increase the accuracy and quantification of the assessment. It should be acknowledged that the complexities of market leakage, the wood products industry and market itself cannot be understated, however, the MARketz Tool has been developed to encompass the most significant factors leading to market leakage risks and has sought to analyze the effects as a whole.

11.2 MARketz Tool

The MARketz Tool utilizes seven different analyses to examine the potential affects project activities will have on the local, regional, and national markets of the host country. This document has been developed to describe the analyses utilized within the tool. Please note, the assessment is conducted within a corresponding Microsoft Excel Workbook with tabs related to each analysis.

11.2.1 Scoring

Five categories of analyses are utilized within the MARketz Tool as described below, with two of the categories having two sub assessments each. The results of each assessment are given a score of 1 (low risk of market leakage), 5 (moderate risk of market leakage), or 9[19] (high risk of market leakage). Scoring criteria is defined within the assessment descriptions below. The resulting scores, weighting of each analysis and determination of the market leakage factor are described later within the section *Market Leakage Factor Calculation*.

1. Market Determination

The market determination assessment and quantification of a Domestic Leakage Factor seeks to define the proportion of potential leakage that will occur in domestic markets versus international markets. As per VCS standard requirements, leakage occurring outside the host country (international leakage), is not quantified[20].

The analysis is derived from/ builds upon part 1 'International Leakage Proportion' of the VCS VM0012 Market Leakage Option 3[21] Assessment method.

Each factor described below is determined via national roundwood production, import, export, and domestic use data. Country specific data is utilized.

The International Leakage Factor (LF_{INT}) is calculated as follows: ($FP_{TO\_DOMESTIC}$) * ($DOM.DEMAND_{FROM\_INTL}$) + (FP_{TO_EXPORT}) * ($EXP.DEMAND_{FROM\_INTL}$), where:

- FP_{TO_EXPORT} = International Demand - is the total project country forest products delivered to export (international) markets (%)
- $FP_{TO\_DOMESTIC}$ = Domestic Demand - is the total project country forest products delivered to domestic markets (%)
- $DOM.DEMAND_{FROM\_INTL}$ = Proportion of total project country forest products to International Markets (%)
- $EXP.DEMAND_{FROM\_INTL}$ = Weighted sum of proportions of key markets which are supplied from non-project country sources (%)

[19] The value of 9 as a maximum rating is utilized to allow for a whole number midpoint (5) between the values of 1 and 9.

[20] Verra - Verified Carbon Standard (VCS), Standard v4.5, 4-October-2023, Section 3.15.11

[21] 3GreenTree Ecosystem Services Ltd & ERA Ecosystem Restoration Associates Inc. 2012. VCS Methodology VM0012 – Improved Forest Management in Temperate and Boreal Forests (LtPF), Version 1.2, Sectoral Scope 14, Section 8.3.5 – Table 5.

The resulting International Leakage Factor is the only factor that is not assigned a score within the tool. Instead, the inverse of this factor (1 - LF_{INT}), the Domestic Leakage Factor, is used to refine the scores of assessments within Categories 3 – 5 (refer to section *Market Leakage Factor Calculation* for more details). The Domestic Leakage Factor is applied to the assessments under Categories 3 – 5 since these assessments utilize project volumes that are attributable to both the domestic and international markets. The resulting score is discounted to accurately account for domestic market effects. The Domestic Leakage Factor is not applied to the assessment within Category 2 – Market Equilibrium, as the model is run on a global scale.

Potential score = 0% - 100%

2. Market Equilibrium

The market equilibrium assessment seeks to determine the effects the project will have on the production and consumption within the host country, while taking a comprehensive set of global economic factors into account.

To achieve this level of assessment, the Global Forest Products Model (GFPM, v2020[22]) developed by Buongiorno et al. is utilized. The GFPM is a dynamic spatial equilibrium model that simulates the global market for forest products and tracks at a country level, annual volumes of timber harvests and changes in forest stock and area. The model incorporates data and parameters of forest resources for 180 countries and 14 forest product categories.

Total timber harvesting landbase (THLB, in thousands of ha) for the country is built into the model. The total project area (in thousands of ha – rounded to the nearest 1000 ha), is then subtracted from the national total to model the project run (i.e. logged to protected).

To run the analysis relating to the project, two runs of the GFPM model are completed. The first run is conducted without adjusting any parameters from the default model inputs establishing the base case. For the second run, the size of the carbon project area (in thousands of hectares) is removed from the project country's starting THLB (edited within the "Forest" tab of the input "World.xls" file), the model is run again forecasting the project case.

The resulting production and consumption records (.xls files) from each run are then compared for the host country. The first year that a disturbance in the amount of total production (thousands of m^3) or consumption (thousands of m^3) is noted and considered the year of the market equilibrium disturbance/ change.

[22] https://buongiorno.russell.wisc.edu/gfpm/

Figure 1 below displays an example of the analysis completed. Within the example, 1000 hectares is removed from the forest landbase in the project case. When comparing the outputs from both the base and the project case, the first year of disturbance to the market equilibrium is identified as 2065.

	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Area (thousands of ha)											
base	11,419.00	11,419.00	11,421.00	11,424.10	11,427.90	11,432.10	11,436.40	11,440.60	11,444.60	11,448.30	11,451.70
project	11,418.00	11,418.00	11,420.00	11,423.10	11,426.90	11,431.10	11,435.40	11,439.60	11,443.60	11,447.30	11,450.70
Difference	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00	- 1.00
Production (Total Roundwood) (thousands of m3)											
base	79,638.70	78,962.80	77,189.00	75,457.40	74,105.60	71,428.50	68,485.70	65,728.00	62,551.50	58,675.30	54,145.10
project	79,638.70	78,962.80	77,189.00	75,457.40	74,105.60	71,428.50	68,485.70	65,728.00	62,551.50	58,673.80	54,143.00
Difference	-	-	-	-	-	-	-	-	-	- 1.50	- 2.10
% difference	-	-	-	-	-	-	-	-	-	0.00	0.00
Consumption (Total Roundwood) (thousands of m3)											
base	73,679.10	73,760.70	73,503.20	73,502.70	73,507.50	71,987.20	70,153.00	68,602.50	66,889.90	64,922.30	62,985.70
project	73,679.10	73,760.70	73,503.20	73,502.70	73,507.50	71,987.20	70,153.00	68,602.50	66,889.90	64,920.80	62,983.60
Difference	-	-	-	-	-	-	-	-	-	- 1.50	- 2.10
% difference	-	-	-	-	-	-	-	-	-	0.00	0.00

Figure 16 Example of Market Equilibrium Assessment

The resulting year of the first disturbance is compared to the start year of the carbon project to determine how many years since the implementation of the carbon project will it take to affect the market equilibrium. Scoring is determined as follows and is based on the VCS Standard v4.5 requirement of a 40-year project longevity (possible score):

- First disturbance occurs less than 20 years after project implementation: 9
- First disturbance occurs within 20 – 40 years after project implementation: 5
- First disturbance occurs within 40 years or greater after project implementation: 1

3. Barriers - A. Distribution Barrier – Cost of Transportation

The distribution barrier assessment is conducted to determine the potential spatial extent of market leakage effects as determined by the cost of transporting wood products.

Under this assessment, the threshold to define a transportation barrier was set as a 15% increase in cost of transport. This value was chosen based on the barrier grade definitions as presented within the VCS Module VMD0033 – Estimation of emissions from market leakage[23].

Peer reviewed sources, or local knowledge is used to determine the thresholds. Average costs for transportation at each scale are also determined for each host country through local knowledge and/or peer reviewed sources.

[23] 3The Earth Partners LLC. 2012. VCS Module VMD0033 –Estimation of Emissions from Market Leakage, Version 1.0, Sectoral Scope 14, Table 2 – Barrier Grades.

The analysis is conducted on a local, regional, and national scale. The thresholds of each scale category are based on the specifics of the host country. For example, the distance of the "local" scale within Germany will not be considered the same within Canada. This assessment is conducted by determining the average cost of transporting wood products in the baseline scenario. It is then determined at what scale the cost of transportation increases by 15% or more and thus represents a barrier. This provides for a reasonable market leakage distance, i.e., the maximum distance a buyer (e.g. a sawmill) would be willing to go to purchase wood products to replace the products removed from the market via the implementation of the project scenario.

Assessment values are assigned based on absence of a transportation barrier at each scale. The scores are compounded and determined in sequence (1 – 3) as the scale of the transportation barrier increases. This effectively sums the scores for the smaller scale markets where a barrier did not exist. Scores are determined as follows:

1. Is there a transportation barrier at the local scale?
    a. Yes = 0
        i. Scoring concludes
    b. No = 1
        i. Continue to next question
2. Is there a transportation barrier at the regional scale?
    a. Yes – overall score = 1
        i. Scoring concludes
    b. No = 5 + 1 = 6
        i. Continue to next question
3. Is there a transportation barrier at the national scale?
    a. Yes – overall score = 5 + 1 = 6
        i. Scoring concludes
    b. No – overall score = 1 + 5 + 9 = 15

Overall scores then receive an assessment score following the criteria below (possible score):

- 0 or 1 = 1
- 6 = 5
- 15 = 9

3. Barriers - B. Regulatory Barrier – Jurisdiction

The jurisdiction barrier assessment is conducted to determine the potential legal extent of market leakage effects as determined by ownership type within the project country. Laws and regulations impacting cut control will vary based on country, and therefore ownership-based restrictions will also vary.

The jurisdictional assessment analysis itself is not a peer reviewed assessment, however all data used in the assessment (i.e. ownership type) must be based on publicly available and verifiable data. Legal interpretations regarding harvest quotas, cutting periods, allowable annual cut and flexibility of harvest volumes must be from government or credible third-party sources.

This assessment is conducted by gathering forest land ownership data and categorizing it by cut control laws and regulations within the project country.

The intent of the jurisdiction barrier assessment is to determine the risk of market leakage based on the legal freedoms of landowners to increase cut allowances. The two ends of the spectrum are private land holdings with perfect free market conditions vs. public forest lands with strong cut restrictions (e.g., Crown Lands in Canada). If a project country has a high proportion of ownership that is regulated by quota-based cut regulations, there is a lower risk of market leakage. Inversely, if a country has a higher proportion of ownership that is unregulated, then there is a higher risk of market leakage.

The proportion of land covered by cut control regulations compared to the national total is scored following the criteria below (possible score):

- Proportion of the national timber harvesting landbase (THLB) covered by quota-based legislation is less than 33%: 9
- Proportion of the national THLB covered by quota-based legislation is greater than 33% but less than 66%: 5
- Proportion of the national THLB covered by quota-based legislation is greater than 66%: 1

4. Product Substitutability

The purpose of assessing product substitutability is to determine if a different product can be used in place of one that would be generated in the baseline scenario. If there is high substitutability, there is a higher risk of market leakage due to the product being easily replaced with another product.

The assessment of product substitutability is conducted partially following the methods as described within the Government of British Columbia's Forest Carbon Offset Protocol (FCOP) v2.0 (Draft)

Peer reviewed sources, or local knowledge is used for this assessment.

To determine a value of overall project substitutability (ɣ) the project species are defined by their harvest contribution (T, as a %) in the baseline scenario. Each species is then given a substitutability score (S) of 100% (perfectly substitutable), 70% (moderately substitutable), or 40% (low substitutability). The substitutability of the project is calculated by summing the harvest contribution of each species (T_{Sp1}, T_{Sp2}, T_{Sp3}, etc.) multiplied by the substitutability score of each species, (S_{Sp1}, S_{Sp1}, S_{Sp1}, etc.).

$$\gamma_{Project} = \sum_{Sp=1}^{Sp*} (T_{\mathrm{Sp}} * S_{\mathrm{Sp}})$$

Where *Sp** = number of species groups in the baseline scenario.

The substitutability of the project is scored following the criteria below (possible score):

- Project Substitutability is less than or equal to 40%: 1
- Project Substitutability is 41% to 70%: 5
- Project Substitutability is greater than 70%: 9

5. Land/Carbon Impact - A. Percent of National Inventory

The percentage of national inventory assessment is conducted to determine the scale of the carbon project compared to the national inventory of the host country. The result of this assessment provides a scaled or proportional analysis of the implementation of the project scenario as it relates to national resources. The smaller the project volume is as a proportion of the national resources, the less risk of market leakage, and vice versa.

The assessment itself is not a peer reviewed assessment, however all data used within this assessment must be based on publicly available and verifiable data.

Data utilized must be based on publicly available (or easily obtained) national forest inventory data (for national data). All project data must be derived from project inventories.

The assessment is completed using a weighted proportion approach. The volume of trees within the baseline scenario inventory is broken down by species and region (where appropriate). Each species is calculated as a percent of the total project inventory. Each species' proportion is then compared to the total volume of that same species within the national forest inventory. These weighted results are then added together to obtain the total weighted volume of the project species as a proportion of the national inventory.

The percentage of national inventory of the project is scored following the criteria below (possible score):

- Project proportion is less than 33% of the national inventory: 1
- Project proportion is between (inclusive) 33% and 66% of the national inventory: 5
- Project proportion is greater than 66% of the national inventory: 9

5. Land/Carbon Impact - B. Biomass Ratio of Project (compared to national inventory)

The assessment of the biomass ratio of the project compared to the national inventory follows the biomass ratio assessment commonly used within several AFOLU methodologies. The purpose of this assessment is to determine the proportion of leakage to other national forests based on the ratio of merchantable biomass to total biomass on the project sites versus the leakage sites. It can be assumed that where a project possesses a higher ratio of merchantable biomass to total biomass than the leakage sites, there is a higher risk of market leakage, and vice versa.

This assessment follows the methods as described within part 2 'Proportional Leakage by Biomass Ratio' of VCS VM0012 Market Leakage Option 3[24] Assessment method.

Data utilized must be based on publicly available (or easily obtained) national forest inventory data (for national data). All project data must be derived from project inventories.

The assessment within VCS VM0012 is described below.

[24] 3GreenTree Ecosystem Services Ltd & ERA Ecosystem Restoration Associates Inc. 2012. VCS Methodology VM0012 – Improved Forest Management in Temperate and Boreal Forests (LtPF), Version 1.2, Sectoral Scope 14, Section 8.3.5 – Table 5.

A weighted average calculation, with the objective of creating an average difference in biomass ratio between the project and the national leakage areas, weighted by the proportion of timber supply coming from each leakage forest type:

- Identify national forest type (or ecotype) data where merchantable log volume biomass and total forest biomass estimates are available (i.e. from published national inventory data sources, etc.)
- Determine the biomass ratio in each national forest type (ratio of merchantable volume in biomass to total biomass;
- Determine the proportion of the domestic national market that is supplied by each of the national forest types (%);
- Determine the difference between the forest type containing the project and each leakage area biomass ratio (Biomass Ratio Difference (%) = ((Project Biomass Ratio – Leakage Area Biomass Ratio) / Project Biomass Ratio) * 100);
- Select the leakage factor for each national forest type, based on the difference between the project biomass ratio and each national forest type biomass ratio (see biomass ratio categories below);
- Multiply the proportion (%) of market supplied by each leakage forest type by the Leakage Factor from each forest type to determine the weighted average as per the scoring criteria for biomass ratios.

Leakage Factors

- >15% Lower merchantable biomass to total biomass = 1
- +/- 15% merchantable biomass to total biomass = 5
- > 15 % Higher merchantable biomass to total biomass = 9

Each value is then given a weighted value based on the proportion of that forest type within the project inventory.

The percentage of national inventory of the project is scored following the criteria below (possible score):

- Biomass ratio score is less 33%: 1
- Biomass ratio score is within (inclusive) 33% and 66%: 5
- Biomass ratio score is greater than 66%: 9

11.3 Market Leakage Factor Calculation

The score of each assessment (1 – 5B) is gathered on the Market Score Card within the excel workbook. The market score card calculates the overall weighted score of all the assessments, produces the resulting assessment score as a percentage, and the corresponding Market Leakage Factor.

11.3.1 Weighted Scores and International Leakage Discount

Assessments 2 – 5B are each multiplied by a value of 0.167 as they are weighted equally within the MARketz tool (i.e. each are 1/6th).

The scores generated from assessments 3 – 5B are also discounted by the percentage of international leakage ($LF_{International}$) as calculated within assessment 1 – Market Determination. The international leakage discount is not applied to assessment 2 – Market Equilibrium as the GFPM already accounts for global (international) market effects.

In the example provided within Figure 2 below, the project was determined as having a 15.3% international market leakage discount. This was applied to the resulting score of assessment 3A – Distribution Barrier – Cost of Transportation to account for effects due to international leakage, as follows:

$$\text{Market Score}_{3A} = \text{Score}_{3A} * \text{Weighting}_{3A} * (1 - LF_{International})$$

$$0.706 = 5 * 0.167 * (1 – 0.153)$$

1			**Market Determination**	**Weighting**
			What percentage of the log supply within the country is attributed to international markets?	
		15.3%	*International market leakage discount (value used to discount national level assessment scores)*	
2			**Market Equilibrium**	
			How long until the project effects the national market equilibrium? (refer to GFPM model)	
		47	*years (from tab 2)*	0.167
		1		**0.167**
			Score Criteria: <20 years = 9, 20-40 years = 5, >40 years = 1 **scoring based on effects during 40 yr project longevity (VCS Standard Requirements for AFOLU project longevity)*	
3			**Barriers**	
	A		**Distribution Barriers - cost of transportation**	
		No	*Barrier exists at local scale?*	
		1.00	*Score*	
		No	*Barrier exists at regional scale?*	
		5.00	*Score*	
		Yes	*Barrier exists at national scale?*	
		0.00	*Score*	
		6.00	*Sum of barrier scores*	0.167
		5		**0.706**
			Score Criteria: 15 = 9, 6 = 5, 1 = 1	

Figure 17. Example project scoring and application of $LF_{International}$ discount.

The international leakage discount is applied to the remainder of the assessments (3B – 5B) in the same manner.

11.3.2 Maximum Weighted Score and Assessment Score

To calculate the final market leakage factor, the maximum weighted score must be determined. The maximum weighted score is determined by multiplying the maximum potential score for each assessment by the assessment weighting (0.167). For assessments 3 – 5B this must be done by multiplying the maximum potential score for each assessment by the weighting and by the international leakage discount.

For the example project provided within Figure 2, the maximum weighted score would be calculated as follows:

Assessment 2: Maximum Score * Assessment Weighting

$$9 * 0.167 = 1.5$$

Assessments 3 – 5B: Maximum Score * Assessment Weighting * (1 - $LF_{International}$)

$$9 * 0.167 * (1 - 0.15) = 1.3$$

Total maximum weighted score (for example) =

Assessment 2 Maximum Weighted Score + Assessment 3 – 5B Maximum Weighted Score

$$1.5 + (1.3 * 5) = 8$$

The Assessment Score of the entire assessment is calculated by summing together the weighted scores, dividing by the sum of the maximum weighted scores, and multiplying by 100 to present the Assessment Score as a percent.

11.3.3 Market Leakage Factor

The market leakage factor scoring matrix (Table 1) was generated by completing an analysis of all possible scoring combination outcomes (excluding international leakage discounts). For the 6 assessments, weighted equally, that could receive a score of either 1, 5, or 9 produces 730 total possible outcomes. For each individual outcome, the scores were summed, and the results were filtered to present unique values only. Those unique values were then divided by the highest possible score (6 * 9 = 54) to present each unique possible outcome as a percentage. The possible outcome percentages were then divided evenly into 5 categories to correspond to the resulting market leakage factors.

To determine the market leakage factor, the Assessment Score is compared to the Market Leakage Factor Scoring Matrix.

Table 27 Market Leakage Factor Scoring Matrix

Market Leakage Factor	Assessment Score (maximum value)
5%	19%
10%	33%
20%	48%

40%	63%
70%	100%

11.4 Conclusion

MARketz Tool utilizes publicly available and verifiable data that results in increased accuracy and quantification of market leakage compared to the options currently made available within the applicable methodology and the VCS Standard. This tool is presented as a methodology deviation and has been utilized to assess the project presented within this PD/MR. This methodology deviation is not intended to be precedent setting.

12 REFERENCES

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