

DARKWOODS FOREST CARBON PROJECT



Document Prepared by Ostrom Climate Solutions (Canada) Inc.



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Monitoring period	01 January 2022 – 31 December 2023
(CCB) GHG accounting period	1 April 2008 – 31 March 2108; 100-year total period
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CCB Standards version	3.1
Project location	British Columbia, Canada

Project proponent(s)	The Nature Conservancy of Canada. Craig Losos craig.losos@natureconservancy.ca. +1 800 465 0029
Validation/verification body	SCS Global Services Hannah Watts hwatts@scsglobalservices.com +1 510-452-8000
History of CCB Status	CCB Validation: 30 June 2014
Gold Level criteria	Biodiversity – The project achieves exceptional biodiversity benefits due to the conservation of critical habitat for endangered ecosystems and species in the Property Area
Prepared by	Ostrom Climate Solutions (Canada) Inc.

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1 SUMMARY OF PROJECT BENEFITS

The Darkwoods Forest Carbon Project creates climate, community, and biodiversity benefits through the acquisition and management of a 54,834.6 ha (135,450 acre) commercial timberland for ecological conservation purposes in perpetuity. The project avoids GHG emissions from logging in the without-project baseline scenario, retains and sequesters significant carbon stocks, retains substantial net benefits for the local communities, and provides exceptional biodiversity benefits from the conservation and management of large-scale fully functional natural ecosystems and critical habitat for key endangered species.

1.1 Unique Project Benefits

Not Applicable. The project benefits are all captured in Section 1.2.

Outcome or Impact	Achievements during the Monitoring Period	Section Reference	Achievements during the Project Lifetime
N/A	N/A	N/A	N/A

1.2 Standardized Benefit Metrics

Category	Metric	Achievements during Monitoring Period	Section Reference	Achievements during the Project Lifetime
GHG emission reductions & removals	Net estimated emission removals in the Project Area, measured against the without-project scenario	Not Applicable		Not Applicable
	Net estimated emission reductions in the Project Area, measured against the without-project scenario	777,817 tCO ₂ e	3.2.4	5,747,711 tCO ₂ e

Forest ¹ cover	For REDD ² projects: Number of hectares of reduced forest loss in the Project Area measured against the without-project scenario	Not Applicable		Not Applicable
	For ARR ³ projects: Number of hectares of forest cover increased in the Project Area measured against the without-project scenario	Not Applicable		Not Applicable
Improved land management	Number of hectares of existing production forest land in which IFM ⁴ practices have occurred as a result of the project's activities, measured against the without-project scenario	1,835.5 ha	5.1	13,141.5 ha
	Number of hectares of non-forest land in which improved land management has occurred as a result of the project's activities, measured against the without-project scenario	4,219.5 ha ⁵	5.1	4,219.5 ha
Training	Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities	Data not available		Data not available

¹ Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO, or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)

² Reduced emissions from deforestation and forest degradation (REDD) – Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)

³ Afforestation, reforestation and revegetation (ARR) – Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)

⁴ Improved forest management (IFM) – Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood, and fuelwood (*VCS Program Definitions*)

⁵ The non-forest area land includes ~4,219.5 ha (including non-treed area, wetlands, streams and water, roads, etc.) which is subject to improved land management. Biodiversity monitoring targets relate to various metrics distributed across the entire property area in each monitoring period. The change in management on non-forest areas is achieved by access management in the project scenario, which affects various biodiversity targets

	Number of female community members who have improved skills and/or knowledge resulting from training provided as part of project activities of project activities	Data not available		Data not available
Employment	Total number of people employed in of project activities, ⁶ expressed as number of full-time employees ⁷	Data not available ⁸		Data not available ⁹
	Number of women employed in project activities, expressed as number of full-time employees	Data not available		Data not available
Livelihoods	Total number of people with improved livelihoods ¹⁰ or income generated as a result of project activities	Data not available		Data not available
	Number of women with improved livelihoods or income generated as a result of project activities	Data not available		Data not available
Health	Total number of people for whom health services were improved as a result of project activities, measured against the without-project scenario	Not Applicable		Not Applicable

⁶ Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers, and community members that are paid to carry out project-related work.

⁷ Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region, or economic territory (adapted from UN System of National Accounts (1993) paragraphs 17.14[15.102]; [17.28])

⁸ The project does not collect total hours worked on project activities, and due to the strict definition given in Footnote 7 (as identified during the verification findings), the project is unable to report estimated project employment for this and presumably future monitoring periods. Prior to the finding the project had estimated the direct employment is estimated using the project expenditures from project monitoring period total results, but using an average compensation level of \$85,925/yr and an FTE based on an average of 1,665 full time working hours per year in Canada (OECD: <https://stats.oecd.org/index.aspx?DataSetCode=ANHRS>) to estimate actual direct employment is the correct way to calculate this, which resulted in 9.6 FTE/yr for this monitoring period, and 88.5 FTE cumulative. Note also that prior monitoring reports had reported this data incorrectly – previously the net benefits FTE shown in Table 17 and 18 were reported, which is different than the estimated direct employment FTE calculated here (the direct employment is an estimate of actual employment from all activities deployed on the project; while the net economic benefits FTE is being used to compare project impacts to baseline impacts).

⁹ See Footnote 8.

¹⁰ Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

	Number of women for whom health services were improved as a result of project activities, measured against the without-project scenario	Not Applicable		Not Applicable
Education	Total number of people for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	Not Applicable		Not Applicable
	Number of women and girls for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	Not Applicable		Not Applicable
Water	Total number of people who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Data not available		Data not available
	Number of women who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Not Applicable		Not Applicable
Well-being	Total number of community members whose well-being ¹¹ was improved as a result of project activities	Data not available		Data not available
	Number of women whose well-being was improved as a result of project activities	Data not available		Data not available

¹¹ Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Health, Education, Water, etc.), but could also include other benefits such as empowerment of community groups, strengthened legal rights to resources, conservation of access to areas of cultural significance, etc.

Biodiversity conservation	Change in the number of hectares significantly better managed by the project for biodiversity conservation, ¹² measured against the without-project scenario	54,834.6 ha ¹³	5.1	54,834.6 ha
	Number of globally Critically Endangered or Endangered species ¹⁴ benefiting from reduced threats as a result of project activities, ¹⁵ measured against the without-project scenario	No change has occurred during this monitoring period: 1 endangered species (whitebark pine) and 1 vulnerable species (Bull trout) on the IUCN Red-Listed Species list and 33 provincially listed significant species at risk	5.1	1 endangered species (whitebark pine) and 1 vulnerable species (Bull trout) on the IUCN Red-Listed Species list, and 33 provincially listed significant species at risk are benefiting from reduced threats as a result of project activities, measured against the without-project scenario

¹² Biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation.

¹³ Biodiversity monitoring targets relate to various metrics distributed across the entire Project Area in each monitoring period.

¹⁴ Per IUCN's Red List of Threatened Species

¹⁵ In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2 PROJECT DETAILS

2.1 Summary Description of the Implementation Status of the Project

2.1.1 Summary Description of the Project (VCS, 2.1, 3.6; CCB, G1.2)

The Darkwoods Forest Carbon Project has been fully implemented under NCC ownership and direct management during this monitoring period. Active management in support of the project's conservation objectives is fully funded and ongoing annually on a daily/weekly basis. As planned, the project implementation periodically includes a low level of timber harvesting, forest management and protection activities, various scientific and biodiversity activities, recreational use, and other non-consumptive uses that support the community, biodiversity, and climate goals of the project.

In order to provide clarity throughout the entire monitoring report, the term Project Area (50,615 ha) is used when referring to the area relevant to emission reductions or removals (ERR) and excludes non-forested areas roads and stream buffers. The term Property Area/Property Boundary (54,834.6 ha¹⁶) is used throughout when referring more generally to the property, or to biodiversity/community benefits over the property and includes the entire Darkwoods property included in this project (excluding Next Creek).

By retaining and conserving the majority of the Property Area, NCC has continued to provide net ecosystem services benefits (i.e. emissions reductions and removals, water quality, etc.) and key ecological benefits for biodiversity. This includes significant protection and enhancements of threatened and endangered species and habitat, along with large-scale fully functioning ecosystems. The local communities continue to benefit from ecosystem services provisioning, economic benefits, and local amenity improvements.

¹⁶ This excludes the stream buffer. Including stream buffer = 54,834.8 ha

Two small timber harvests occurred in 2022, totaling 34.9 ha and one harvest occurred in 2023 totalling 30.6 ha, with a total of 65.5 ha harvested during the monitoring period. There were two fires on the Darkwoods Property in 2022, two of which covered ~702 ha of land in the Property Area. In 2023, there were four minor fires, covering ~2ha of land in the Property Area. The resulting estimated carbon stock changes have been accounted for in the ex-post calculations. These fires do not constitute a loss event, and the buffer contribution is not impacted. There has been no activity shifting leakage, and market leakage has been tracked and accounted for in accordance with the methodology. Significant biodiversity, ecosystem services, and other community net benefits continue to result from the project during this monitoring period. The project continues to manage and mitigate project risks in a manner consistent with the VCS AFOLU Non-Permanence Risk Tool assessments and has been updated to the current v4.2 (effective Jan 1, 2024). Due to the increase in the minimum risk score allowable by the risk tool from 10% to 12%, the project risk rating is now 12%.

The project has generated net GHG emission reductions of 777,817 tCO₂e over this two-year monitoring period.

Throughout the monitoring period the project area continued to provide net benefit to communities through access to the property area for recreation, research, and contract work opportunities. The project was open for public comment from 14/08/2023 to 14/09/2023, and reopened from 09/06/2025 to 09/07/2025. No comments were received. NCC maintained open communication channels with all stakeholders throughout the monitoring period via updates to the project webpage, informational meetings, and direct conversations as requested. Several informational meetings with stakeholders were held during the monitoring period as outlined in Section 2.3.4 of this monitoring report.

Continued implementation of the project activities throughout this monitoring period resulted in net positive impacts to biodiversity. Ongoing project activities included protection and management of old growth forest areas, and maintaining access control on the property through gates, access permits, and road deactivation. Key milestones in project implementation during the monitoring period related to biodiversity objectives included minor harvesting to maintain forest health and fire resiliency, post-fire restoration following a fire-related loss event that occurred in 2021, and planting of 87,025 Whitebark pine seedlings.

2.1.2 Audit History (VCS, 4.1)

Audit Type	Period	Program	VVB Name	Number of years
Validation	April 21, 2011	VCS	Rainforest Alliance	One year

Verification	April 01, 2008 – December 31, 2010	VCS	SCS Global Services	Three years
Verification	January 01, 2011 – December 31, 2012	VCS	SCS Global Services	Two years
Verification	January 01, 2013 – December 31, 2016	VCS/CCB	SCS Global Services	Four years
Validation	June 30, 2014	CCB	SCS Global Services	One year
Verification	January 01, 2017 – December 31, 2019	VCS/CCB/SD VSta	Aster Global Environmental Solutions, Inc	Three years
Baseline re-validation	September 2020	VCS/CCB	Aster Global Environmental Solutions, Inc	One year
Verification	January 01, 2020 – 31 December 2021	VCS/CCB/SD VSta	Aster Global Environmental Solutions, Inc	Two years
Validation	March 11, 2021	SD VSta	Aster Global Environmental Solutions, Inc	One year
Verification	January 01, 2022 – 31 December 2023	VCS/CCB/SD VSta	SCS Global Services	Two years

2.1.3 Sectoral Scope and Project Type (VCS, 3.2)

Sectoral Scope	14: Agriculture, forestry, and other land use
AFOLU Project Category	Improved Forest Management (IFM)
Project Activity Type	Logged Forest to Protected Forest (LtPF)

2.1.4 Project Proponent (VCS, 3.7; CCB, G1.1)

Organization name	Nature Conservancy of Canada (NCC)
Contact person	Craig Losos

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2.1.5 Other Entities Involved in the Project

Organization name	Ostrom Climate Solutions (Canada) Inc.
Role in the project	Project Implementation Partner
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Title	Director, Carbon Intelligence Services
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Email	jack.satzewich@ostromclimate.com

2.1.6 Project Start Date (VCS, 3.8)

Project start date	01-April-2008
Justification	The project start date is the date NCC acquired the property. The GHG emission reductions began the day of acquisition, when avoided logging began due to NCC's ownership. The project also initiated the pipeline listing process within three years of the project start date and has completed validation within five years of the project start date

2.1.7 Benefits Assessment and Project Crediting Period (VCS, 3.9; CCB, G1.9)

Crediting Period	100 years, conforming with the VCS Program requirements of 20 years minimum up to a maximum of 100 years.
Start Date of First or Fixed Crediting Period	01-April-2008 to 31-March-2108

Total Number of Years of Crediting Period	100 years
CCB Benefits Assessment Period	100 Years, Project lifetime

2.1.8 Project Location (VCS, 3.11; CCB, G1.3)

The Darkwoods property is a 54,834.6 ha (135,450 acre) contiguous parcel of fee simple private property in southeastern British Columbia just northwest of the municipality of Creston. The Darkwoods property is bounded by Kootenay Lake on the east and various crown and private lands on the other property boundaries. There is a significant in-holding in the center of the property that was purchased by the NCC in 2018 but is not part of the Darkwoods Carbon Project and all numbers reported here do not include this parcel. The boundaries are surveyed (Table 1) with the following legal and land description:

Table 1: Legal Descriptions and Parcel Identifiers of Darkwoods Parcels

PID#	Description
PID 007-608-349	Sublot 1, District Lot 2381, Kootenay District, Plan X74, except (1) Plans 1760 and NEP77791 and (2) Part in Lot 15184 known as "Tramline" MC
PID 007-608-594	Sublot 7, District Lot 2381, Kootenay District, Plan X74
PID 007-608-446	District Lot 887, Kootenay District, except part included in Plan 1760
PID 026-235-927	District Lot 15184, Kootenay District

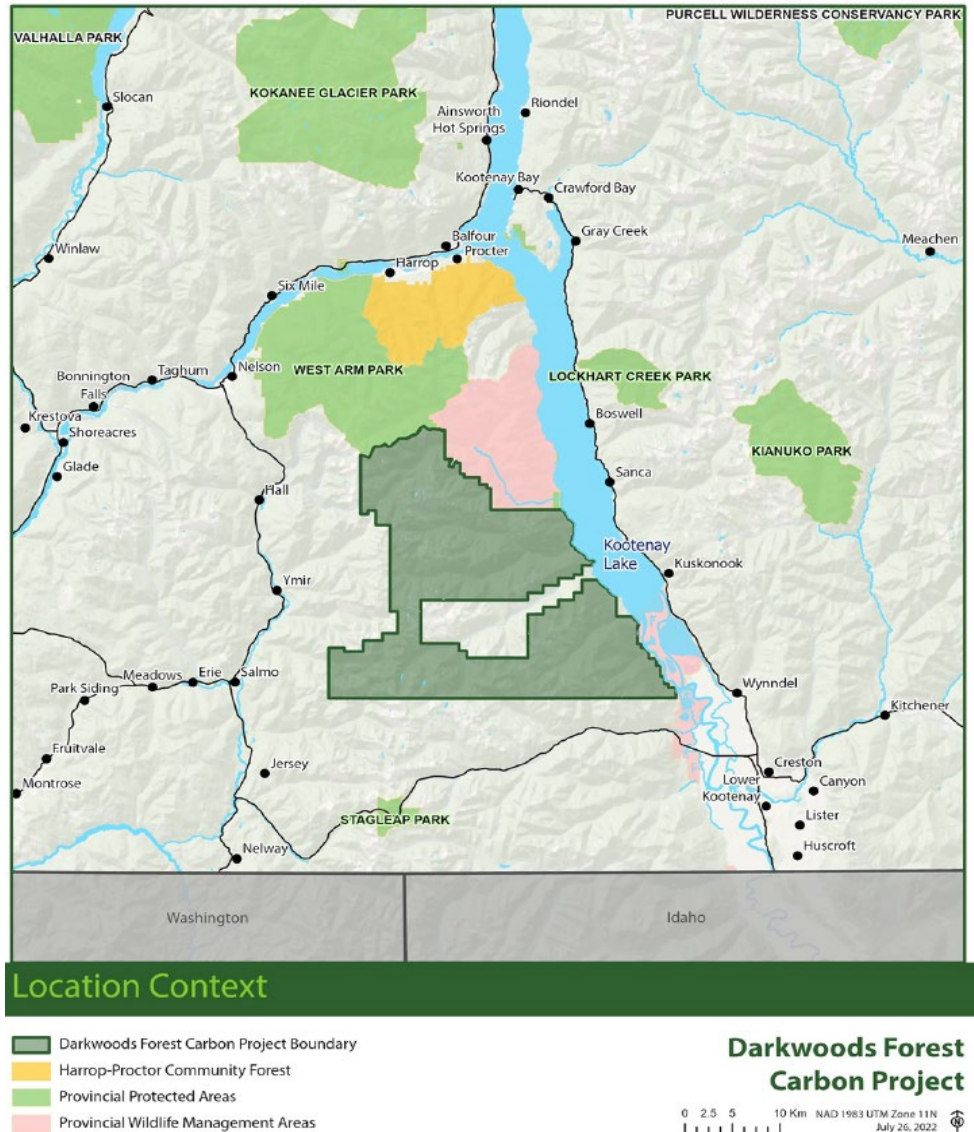


Figure 1: Darkwoods Property Area Overview Map

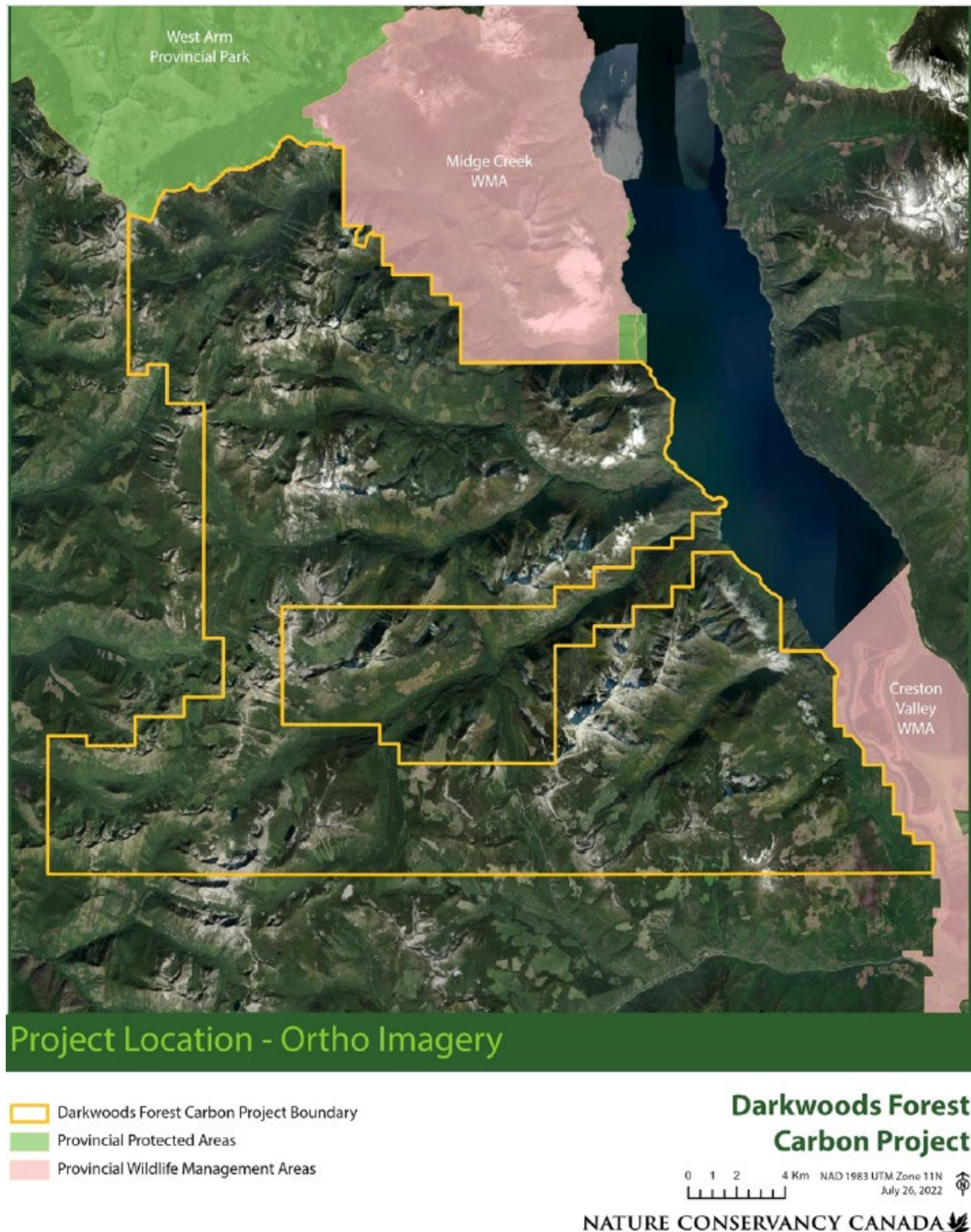


Figure 2: Darkwoods Property Area Ortho Photo



☒ KML file has been provided

2.1.9 Title and Reference of Methodology (VCS, 3.1)

Type (methodology, tool, module)	Reference ID (if applicable)	Title	Version
Methodology	VM0012	Improved Forest Management in Temperate and Boreal Forests (LtPF)	1.2
Tool		VCS AFOLU Non-Permanence Risk Tool	4.2
Tool	VT0015	Calculation of Reductions and Removals for VM0003, VM0005, VM0012, and VM0034	1.0

2.1.10 Double Counting and Participation under Other GHG Programs (VCS, 3.23; CCB, G5.9)

2.1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program, or any other form of community, social, or biodiversity unit or credit?

☐ Yes

☒ No

2.1.10.2 Registration in Other GHG Programs

Was the project registered or seeking registration under any other GHG programs?

☐ Yes

☒ No

2.1.10.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes

☒ No

2.1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions (VCS, 3.24)

2.1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the VCS Program Definitions for definitions of emissions trading program and binding emission limit.

☐ Yes☒ No

2.1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the VCS Program Definitions for definition of GHG-related environmental credit system.

☐ Yes☒ No

2.1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes☒ No

2.1.12 Sustainable Development Contributions (VCS, 3.17)

The project aims to implement a reduced harvest regime in conjunction with management of the property for conservation purposes. Implementation of such activities allows for a number of SD contributions. Reduced harvest activities result in an avoidance of CO₂ emissions and the retention and protection of forest biomass allows for the removal of CO₂ emissions. This project also contributes to achieving the goal of “30 by 30”¹⁷, which aims to safeguard the planet’s biodiversity, enhance, and restore ecosystems, halt species extinction, and maintain genetic diversity. The project intends to do so through an avoided harvest, and through the protection and management of a regionally significant land area with fully functional natural ecosystems that provides critical habitat for vital biodiversity including key endangered species. Implementing a reduced harvest and conservation-based regime will also work towards a number of water related benefits, including improved water quality, increased quantity, timing of flows, and important aquatic habitat improvements.

This project is also developed alongside SD VISTA, and the associated Sustainable Development Goals (SDG) the project asserts will be discussed further in the accompanying SD VISTA Monitoring Report.

¹⁷ <https://www.canada.ca/en/environment-climate-change/news/2022/12/government-of-canada-recognizing-federal-land-and-water-to-contribute-to-30-by-30-nature-conservation-goals.html>

Table 2. Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	Gross Carbon Emissions Reductions (2022 - 2023): 809,948 tCO ₂ e	Gross Carbon Emissions Reductions (2008-2023): 5,779,842 tCO ₂ e
2)	15.2	15.2.1: Progress towards Sustainable Forest Management	Implemented activities to increase	Forest Biomass (2022 - 2023): net ~ha of avoided clearcut harvesting: 1,835.5 ha	Forest Biomass (2008-2023): net ~ ha of avoided harvest to date: 13,141.5 ha
3)	6.6	6.6.1: Change in the extent of water-related ecosystems over time	Implemented activities to increase	Water: The project no longer reports annually on ECA analysis, which is now done on a 5-year reporting schedule. Therefore, no new results were reported during this monitoring period.	Water: The project has improved the ECA on 100% of the watersheds in comparison to the baseline scenario. Currently the entire Property Area has an ECA below 25%.
4)	15.5	Various indicators	Implemented activities to increase	Biodiversity: various indicators, see Table 32	Biodiversity: various indicators, see Table 32

2.2 Project Implementation Status

2.2.1 Implementation Schedule (VCS, 3.2; CCB, G1.9)

The Darkwoods project has been fully implemented and has consistent and stable ongoing project activities and monitoring. This monitoring period represents years 15-16 of the ongoing project and includes the calendar years 2022 and 2023.

During this monitoring period, NCC continued to implement the Darkwoods Property Management Plan (PMP) and undertaken all required monitoring activities as described in the latest PMP document.

During the monitoring period, 65.5 ha of harvest occurred.

Table 3. Milestone Timeline

Date	Milestone(s) in the project's development and implementation
Apr 1, 2008	Project start date - Darkwoods property acquisition closing date and start of project activities.
Sep, 2009	Road management plan implemented with initiation of road deactivation
Sep, 2009	Access control management planning implemented
May 4, 2011	VCS Project Validation
May 4, 2011	VCS Project Verification: 2008, 2009, 2010
Oct, 2011	Carbon permanent plot network installed 59 plots
Jan, 2013	Annual harvest level reduced below 10,000 m ³ /yr
Mar 3, 2014	VCS Project Verification: 2011, 2012
Jun 30, 2014	CCB Project Validation
Jun 30, 2014	CCB Project Verification: 2010, 2011, 2012
Sep, 2014	Additional installation of 12 permanent plots
Sep-Oct, 2016	Re-measurement of initial 59 permanent plots
Feb 27, 2018	VCS and CCB Project Verification: 2013, 2014, 2015, 2016
Jul, 2019	Re-measurement of 12 permanent plots installed in 2014
Sep, 2020	VCS PD 10-year re-validation
Sep, 2020	VCS and CCB Project Verification: 2017, 2018, 2019
Sep 1, 2020	Formal monitoring over-flight of Property Area in 2020. Other flights and ground monitoring occurred throughout 2020
Mar 11, 2021	SD VISta Project Validation
Mar 11, 2021	SD VISta Project Verification for 2017, 2018, 2019
Sep-Oct, 2021	New LiDAR-derived enhanced forest inventory was undertaken

Sep-Oct, 2021	31 new permanent sample plots installed (11 of which were in Next Creek for LiDAR/EFI validation purposes), including replacement of certain high cost, remote helicopter plots, in addition to LiDAR flown. 43 plots were remeasured.
Sep, 2021	Formal monitoring over-flight of Property Area in 2021. Other flights and ground monitoring occurred throughout 2021.
Sept 26, 2022	Formal monitoring over-flight of Property Area in 2022. Other flights and ground monitoring occurred throughout 2022.
Sept 20, 2023	Formal monitoring over-flight of Property Area for 2023. Other flights and ground monitoring occurred throughout 2023.
Dec 31, 2023	Forest inventory updated to include all activities to date
Mar 18, 2024	VCS & CCB Verification for 2020, 2021
Mar 18, 2024	SD VSta Project Verification for 2020, 2021
Expected 2025	VCS/CCB project verification for periods 2022, 2023
Expected 2025	SD VSta project verification for periods 2022, 2023
Annually; ongoing	Property Area monitoring on a daily/weekly and annual basis

2.2.2 Baseline Reassessment (VCS, 3.2.6, 3.2.7)

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes ☒ No

2.2.3 Methodology Deviations (VCS, 3.20)

During this monitoring period there is a new methodology deviation. For continuity, all prior period deviations are shown here in the same sequence as prior monitoring reports:

- The 2013-2016 Monitoring Report noted the plot remeasurement took place slightly outside the 5-year remeasurement period, which was verified as immaterial to carbon stock accounting. From this point forward, the project has interpreted the VM0012 requirement of 5 years to mean within 5 field seasons rather than precise calendar dates. This is immaterial to carbon stock modeling and is a better fit to practical field work logistics. This prior deviation affects the current monitoring period indirectly as these plot remeasurement data are in use.

- There is a minor deviation from the methodology and related monitoring plan elements described in the VCS PD (2018). While the plot network has been expanded during the project, the project does meet the stated criteria from VM0012 of having a minimum of one plot in every analysis unit. Currently there is one Analysis Unit (AU 110) without plot representation. However, this AU is very small and represents <0.01% of the productive forest area on Darkwoods, and therefore is immaterial to the calculation of carbon stocks and emission reductions. A hypothetical sensitivity analysis was verified in the 2013-2016 Monitoring Period to demonstrate immateriality to the uncertainty factor calculations. This deviation continues in the current monitoring period.
- The previous listed methodology deviation related to an error in VM0012 formula 60b has been corrected in an errata update to VM0012, and therefore is no longer applicable.
- A minor deviation, first implemented in the 2013-2016 monitoring period, was noted to not measure plots which are located within the non-productive landbase (i.e. AU 111). This is an ongoing deviation that has been previously verified to have no impact on the calculation of GHG emission reductions. This deviation continues in the current monitoring period.
- The 2013-2016 Monitoring Report noted a minor methodology deviation related to the source of data used to report the volume of harvested wood used to calculate carbon in the harvested wood product pool. The project uses the government issued scaling reports to determine project harvest volumes, which is consistent with the newer versions of the VM0012 v1.2 (Section 8.2.10). This deviation has been previously verified to not impact the conservativeness of the calculation of GHG emissions. The project intends to continue this deviation on an ongoing basis, as the provincial scaling reports are the best source of data, and consistent with updated VM0012 versions. This prior deviation does not affect the current monitoring period¹⁸.
- A minor deviation has been applied in the 2022-2023 monitoring period regarding the alignment of field plot remeasurement schedules. The 5-year remeasurement rotation of 12 of the field plots (16% of the total field plots) are out of sync with the 5-year rotation of the remaining 63 plots (a total of 75 plots). These 12 plots are due for remeasurement in 2024 and the remaining 63 plots are due in 2026. The project proponent has applied a one-time deviation to postpone remeasurement of these 12 plots until 2026, to bring them in alignment with the remaining plots. This adjustment is more efficient for project-specific circumstances and will have no impact on this monitoring period. This deviation will improve the accuracy of the forest inventory as all plots will be used for carbon quantification at the same time. As of 2021, Plot ID 108-2 burned in a fire, which now leaves a total of 74 plots on the property.

¹⁸ Please see the first bullet point on page 24 for the PD deviation which overrules this methodology deviation.

- A minor deviation has been recorded in the 2022-2023 monitoring period to formally document a change implemented since the 2011-2012 monitoring period. The deviation relates to the calculation of the non-permanence buffer in the Darkwoods Carbon Model spreadsheet. Specifically, the project adjusted the gross emission reductions to remove fossil fuel emissions from equipment, transport, and manufacturing before applying the buffer, whereas the methodology does not explicitly require this separation. The project implemented this adjustment to ensure that the buffer is applied only to reversible carbon pools, remaining consistent with the intent of the VCS AFOLU Non-Permanence Risk Tool v4.2 (Section 1.1.5). This deviation improves the accuracy of the buffer pool calculation. The project intends to continue this approach in ongoing monitoring periods to remain aligned with the intent of the VCS Non-Permanence Risk Tool.
- A methodology deviation was applied in the 2022–2023 monitoring period to recalculate tree height at the stand level using LiDAR data instead of field measurements in sample plots, as originally required by Section 9.2 of the VM0012 methodology. In previous monitoring periods, top height was measured directly from field inventory plots at each Stand ID level, but this approach did not fully capture height variability within the stand. The deviation applied in this monitoring period uses LiDAR data collected in 2021 to generate a stand-level tree height dataset that accounts for height variability across all trees. This approach provides a more accurate and comprehensive representation of tree height while maintaining a conservative and verifiable estimate of project carbon stocks. Documentation of this process is provided in the accompanying report¹⁹.

2.2.4 Minor Changes to Project Description (CCB Program Rules, 3.5.6)

Not applicable.

2.2.5 Project Description Deviations (VCS, 3.21; CCB Program Rules, 3.5.7 – 3.5.10)

During this monitoring period there are new Project Description (PD) deviations. For continuity, all prior period deviations are shown here in the same sequence as prior monitoring reports:

- As part of the 2013-2016 monitoring period the project submitted an updated KML file for the boundary of the project to Verra to correct a minor discrepancy. The new Project Area is 54,870 ha, which is the area in use for the project GIS data and related modeling in the 2017-2019 monitoring period.

¹⁹ Darkwoods Tree list Methodology_Feb5-2025.docx

- In the 2013-2016 monitoring period, a PD deviation was noted related to the use of literature values for wood density rather than direct lab measurements of wood density. This deviation is related to the interpretation of the language in VM0012 procedures and the related Footnote 8 in Section 3.3. of the PD). The project has continued to use literature-based values for wood density to maintain consistency in carbon calculations on an ongoing basis and expects to continue this practice ongoing. This decision has been verified as immaterial to GHG emission reduction calculations (see discussion in 2013-2016 Monitoring Report). This deviation is ongoing.
- The 2013-2016 Monitoring Report identified a PD deviation related to the lack of adequate description and justification for the implementation of an updated and improved forest inventory on the Project Area in 2011-2012. This improved descriptive information was provided and verified in the 2013-16 verification. The project has continued to utilize the 2011 improved inventory for property management and the carbon project until better inventory data becomes available. No further action for this deviation is necessary.
- The 2013-2016 Monitoring Report noted a PD deviation related to the interpretation of the PD documentation with respect to installing the plot network (see further description in the 2013-2016 report). The deviation does not require further action.
- Previous Monitoring Reports have noted the methodology deviation #1 described in Section 2.2.3 is also a PD Deviation. This relates to the strict calendar year definition of the 5-year plot remeasurement period. Similar to the methodology deviation, this interpretation and section 3.3 of the PD have been updated to accommodate five field seasons between plot remeasurements. No further action is required for this deviation.

- During the 2017-2019 monitoring period the project has shifted from the use of the FORECAST and ATLAS models to the use of the USFS Forest Vegetation Simulator (FVS) with the Fire and Fuels Extension (FFE) module, and the harvest scheduling model Forest Projection System (FPS). This change is being made to move to a more widely accepted and more actively supported model that is build and maintained by the U.S. Forest Service. FVS-FFE is widely used in both forestry applications and in forest carbon projects across North America, and hence the Darkwoods project is updating its model usage to a more broadly available and used model. FVS meets all of the requirements of VM0012 and is well documented and referenced for use in both the Project Area and the calculation and tracking of all the required carbon pools in manner consistent with the VCS AFOLU guidelines, VM0012, and the Darkwoods PD. The new models are applied starting from the 2011 Darkwoods VRI inventory, and results modeled forward consistently to this monitoring period. The prior period carbon results are unchanged, and the new monitoring period results are independent of prior modeling (i.e. they are run out consistently using the same original forest inventory stand data along with the same spatial data polygons used previously. There is therefore no 'overlap' in model results or merging of model outputs. Data modeled forward from the 2011 inventory and within this monitoring period utilize the same models, processes, assumptions, and underlying datasets consistently between the project and baseline scenario, meaning the net emission reduction calculations are consistent between scenarios. The new models follow the PD and VM0012 to calculate the emission reductions in each scenario, and hence there is no deviation from the PD process. But a deviation is listed here for clarification and explanation due to the explicit reference to the use of FORECAST and ATLAS in the PD. This change in models does not impact the primary inventory data, nor the methods used to calculate carbon emissions and carbon pool accounting. A further discussion of the use of FVS-FFE and related databases/spreadsheets is included in Appendix 1.
- A PD deviation was made in the 2017-19 Verification to a change in the method for calculating market leakage. 2017 is the 10th year of the project, and hence the project is required to undergo a re-validation of the baseline scenario and general updating of the PD documentation to the latest VCS and VM0012 versions. In the original PD, the project selected the option to follow the CAR-based leakage calculation method. Due to changes in the CAR leakage approach in the latest CAR versions, this method is no longer aligned with the leakage reference materials or other major carbon standards such as California ARB or the VCS default market leakage rates. Therefore, after discussion with Verra, the project has elected to use the VCS default market leakage rate option from VM0012. This change increases the effective deductions for market leakage and do not increase the emission reductions claimed by the project.

- A PD deviation was made in the 2017-2019 verification to the method used to calculate Harvest Wood Products. This change has been made to come into compliance with the latest version of VM0012 v1.2. This changes the HWP calculations from the “100 Year Method” described in the PD and used in prior monitoring periods, to a HWP product decay curve approach consistent with the 1605b methods. This results in a material reduction in the emission reductions claimed by the project in this monitoring period, as carbon associated with baseline scenario harvesting is tracked in decay pools rather than immediate emission. The FVS-FFE model models this calculation and tracks the required HWP pools natively.
- A PD deviation was made in the 2017-2019 verification to alter the analysis unit (AU) regeneration assumptions. Previously, representative AU stand carbon yield curves were created using a specific set of variables and applied at the AU level. The old criteria were listed in Table 10 in the Darkwoods VCS PD (Darkwoods - VCS Project Design Document - 2010 v.1.8d). FVS-FFE has natively build capability to simulate natural forest regeneration after harvest and natural disturbances at the stand level based on habitat classes and prior stand attributes. Therefore, for natural regeneration in the baseline, only the Regen Delay field was applied. FVS therefore regenerates each stand. The Endemic Mortality field was simplified to 0.04 for all AU's and is equivalently applied by FVS using the FixedMort keyword. For managed stands, the species, species percentages, planting density, and regen delay fields were used as input to the FVS-FFE model managed stand regeneration fields. Note that FVS only allows the first 2 species, so any 3rd species were removed, and the percentage distributed evenly to the first two species. The Endemic Mort field was treated the same as for natural regeneration. These changes are a more precise (and realistic) stand level simulation of for both natural and managed regeneration using the FVS-FFE model. This is an improvement to project accuracy and does not systematically increase or decrease emission reductions claims by the project¹⁶. The project has continued the use of FVS-FFE's stand level regeneration capabilities in the 2020-21 monitoring period.
- A new PD deviation was made in the 2020-2021 monitoring period to improve inventory and carbon calibrations and accuracy. This deviation does not impact the applicability of the methodology, additionality, or the appropriateness of the baseline scenario. In 2021 NCC undertook a new LiDAR-derived forest inventory which has further brought the stand level inventory metrics up to current. The field inventory plots were used to 'train' and validate LiDAR data. The LiDAR was then used to create the Enhanced Forest Inventory which was used for carbon stock monitoring. A 20m x 20m Enhanced Forest Inventory was created from the LiDAR data containing attributes for Height, Crown Cover, Biomass, Volume, Basal Area, and Stems per hectare. The Enhanced Forest Inventory attributes were then aggregated into the original inventory polygons, which feed into the carbon model. The updated inventory results in increased accuracy of carbon stock quantification and therefore the quantification of emission reductions and removals.

- A PD deviation was made in the 2020-21 monitoring period to change how the Project Area analysis unit (AU) stratifications are defined. In this monitoring period a new LiDAR-derived enhanced forest inventory was undertaken in 2021. The carbon plots sampling available in this monitoring report did not match well to the prior analysis unit stratification definitions, potentially because the prior AU definitions were not clearly stratifying the landbase on parameters that are directly related to carbon stocks. Previously, the AUs were determined primarily by species groupings, site index, and an age breakpoint. In retrospect, these parameters are not necessarily well correlated to expected carbon stocks, and the sample plot analysis showed significant variation at the plot level in the last verification as well. These original criteria were effective in the pre-2017 modeling approach that used representative stand metrics at the AU level, as compared to the stand level actual inventory metrics used within FVS-FFE. The prior 2017-2019 verification saw a significant increase in inventory/plot error, which resulted in an Uncertainty Factor of 4.9% (well above the target 1.5%). Initial analysis from the current monitoring report indicated a further increase in the Uncertainty Factor and inventory error against the plot data when rolled up into an AU basis. Therefore, the project reviewed the analysis unit stratification and decided to change to a stratification based on basal area in 10 unit increments Basal area (BA) is a commonly used forestry mensuration term imbedded or easily calculated from forest inventory and also from the plot sampling. BA is a more direct representation of the inventory stand volume and stand carbon volume (at least in the major carbon pool of above-ground live biomass). The effect of this change to BA stratification is a marked improvement in plot level variability (as compared to the inventory at a polygon level), and a strong improvement in plot vs. inventory standard error at an AU level as well. BA appears to be a much more suitable parameter to use for the stratification of the Darkwoods inventory into Analysis Units.

This change does not affect the primary inventory stratifications made for non-productive areas (AU 888), low productivity stands (AU 111) (although please see further deviation below regarding AU 888 and AU111, affecting monitoring period 2022-2023 onwards), the timber harvesting landbase (THLB), or stand operability parameters. This change has been made in both the Project and Baseline carbon analysis. This change does not directly affect emission reductions in either scenario, however it does result in bringing the project Uncertainty Factor (UF) calculation within its target error range. This reduces the UF deduction in the project. It is an objective of the project to improve inventory and carbon calibration and accuracy over time.

Table 4. Prior assignment criteria for carbon analysis units

AU	Description	Lead Species	Other Species	Prod Class	Site Index Range ¹⁸	Age
101	Fd / L* / Bg / Py_med	Fd / L* / Bg / Py	PI	med	>12 <18	>40

102	Fd / L* / Bg / Py_good	Fd / L* / Bg / Py	H & C	good	>17	>40
103	B / L* / Fd / S* / Py / Pw_poor	B / L* / Fd / S* / Py / Pw	S, PI	poor	> 7 & <13, > 7 & <14 for S	>40
104	BL_med	BL	S,PI	med	>=13	>40
105	PL_poor	PL	B, S	poor	<13	>40
106	BL_med	PL	F, S	med	>12	>40
107	CW / HW_med-good	CW / HW	S,F	medgood	all	>40
108	S*_med	S*	BI, PI	med	>13 <17	>40
109	S*_good	S*	F, H, C	good	>16	>40
110	E / A_Med	E / A		med	all	All
111 ²⁰	B / L* / Fd / S* / Py / Pw_	B / L* / Fd / S* / Py / Pw			<8	All
201	F / L_med	F / L	PI	med	13-17	<=40
202	F / L_good	F / L	PI	good	>17	<=40
203	S/P/B poor	S/P/B	L	poor	<13	<=40
204	S/B Med	S/B	L	med	>12 for BI, >12 & <17 For S	<=40
206	P_med	P	F, S	med	>7	<=40
207	C / H_med-good	C/H	F, S	medgood	all	<=40
209	S_good	S	F, H, C	good	>16	<=40

²⁰ Please note that another deviation has been applied to AU111 and is noted below for Monitoring Period 2022-2023.

888	Non-forest					
	MPB curves					
AU	Description	Lead	MPB Curve	Prod class	SI range	Age
406a	P_med	Fd/Hw/Py/Lw/PI	Y	med	>7	<86
406b	P_med	Fd/Hw/Py/Lw/PI	Y	med	>7	>85

Table 5. Analysis criteria updated for the 2020-2021 monitoring period and continued into 2022-23

AU	Basal Area Criteria
5	BA: >0 to <=10
15	BA: >10 to <=20
25	BA: >20 to <=30
35	BA: >30 to <=40
45	BA: >40 to <=50
55	BA: >50 to <=60
65	BA: >60
888	Non-Forest

- A PD deviation was made in the 2020-21 monitoring period to fine tune the Project Area. The Project Area has been updated to 54,834.6 ha (previously 54,870.4 ha). This is a decrease of 0.065% and relates to blank sliver polygons discovered between the inventory polygons and the boundary polygon. This area is de minimis, and the removed area does not have any inventory (blank polygons) and does not increase emission reductions claimed by the project.

- Specific to CCB, the project has noted a deviation in the biodiversity monitoring reporting period in conjunction with an update of the Darkwoods Property Management Plan (PMP) and biodiversity monitoring plan as part of adaptive management. The CCB PD refers to annual biodiversity monitoring and reporting (as shown in the 2011 PMP), which has been updated to monitoring reporting every 5 years in the 2016 PMP. The latest PMP (2020) covers the 5-year period 2021-2025, inclusive of this monitoring period. It is expected the 5-year reporting schedule will continue in the future but may be subject to change in future PMP updates.
- A PD deviation was made in the 2020-21 monitoring period to correct a data entry error in section 1.10, within the table that lists the 'Estimated Annualized GHG emission reductions or removals (tCO₂e)'. Table 6 below summarizes the incorrect values included in the PD and the updated values, The value of 452,612 listed for 2020 has been removed and the values for all subsequent years have been shifted back by a single year to correctly pair the estimated annualized GHG ERRs with the appropriate year. This deviation does not impact the applicability of the methodology, additionality, or the appropriateness of the baseline scenario. There is no change to the GHG ERRs claimed in a previously verified monitoring period as a result of this PD deviation. The error occurred during the preparation of the PD in 2018 that was updated to reflect the project's improved inventory data. The table now matches the values from the original PD, dated 2011.

Table 6. Estimated annualized GHG Emission Reductions or Removals

Year	Estimated Annualized GHG emission reductions or removals (tCO ₂ e) Incorrect	Estimated Annualized GHG emission reductions or removals (tCO ₂ e) Updated
2008	317,823	317,823
2009	331,727	331,727
2010	439,461	439,461
2011	435,748	435,748
2012	427,496	427,496
2013	371,602	371,602
2014	405,719	405,719
2015	367,248	367,248
2016	414,790	414,790

2017	263,116	263,116
2018	231,998	231,998
2019	315,986	315,986
2020	452,612	413,921
2021	413,921	430,528
2022	430,528	440,911
2023	440,911	290,837
2024	290,837	131,601
2025	131,601	126,403
2026	126,403	243,925
2027	243,925	134,467
2028-2032	134,467	127,468
2033-2037	127,468	116,801
2038-2042	116,801	158,659
2043-2047	158,659	97,842
2048-2052	97,842	81,649
2053-2057	81,649	117,388
2058-2062	117,388	119,179
2063-2067	119,179	90,160
2068-2072	90,160	74,324
2073-2077	74,324	41,217
2078-2082	41,217	10,230
2083-2087	10,230	75,355
2088-2092	75,355	139,373
2093-2097	139,373	107,151
2098-2102	107,151	113,304

2103-2107

113,304
83,095

- A PD Deviation was made in the 2020-2021 monitoring period to improve NCC's monitoring plan and process for capturing any future events that qualify as a loss event in the Project Area. As outlined in the monitoring plan, NCC undertakes annual inventory change monitoring, including monitoring for natural disturbance events >4 ha and unplanned man-made disturbances. NCC will conservatively undertake an assessment of all disturbance events >500 ha (equivalent to less than 1% of the Project Area) to determine whether the event qualifies as a loss event according to VCS Program Definitions. Once the appropriate data becomes available (ex. provincial fire severity data), NCC will use the modelled change in carbon stocks within the Project Area to calculate whether the event qualifies as a loss event. If a loss event has occurred, NCC will notify Verra and issue a loss event report and representation following the requirements outlined in the VCS Registration and Issuance Process. This deviation does not impact the applicability of the methodology, additionality, or the appropriateness of the baseline scenario.
- A new PD deviation was made in the 2022-23 monitoring period to recalculate the height, DBH and number of trees at the stand level. In the previous monitoring period, top height was taken at each Stand ID level which indicated the tallest trees, the most dominant trees and the most codominant trees at each Stand ID level, but this did not account for tree height variability within the stand. The deviation applied in this monitoring period is a recalculated tree list based on LiDAR that was flown in 2021. More information on the process that was taken to recalculate tree height can be found in the accompanying document²¹.
- A new PD deviation was made in the 2022-2023 monitoring period to remove references to analysis units no longer in use and update the definition of non-forest. AU111 is no longer in use, as per the updated analysis unit criteria from the 2020-2021 monitoring period, and references to AU111 have been removed. The non-forested stands, has also been updated to align with the IPCC definition of forest:
 - >10% Crown Cover
 - >5m mature tree height (Site Index used to indicate mature height)
 - >0.5 hectare polygon size

By using the above criteria, we can more accurately represent the forested landbase as they are derived from LiDAR informed attributes in the forest inventory, as well as a GIS calculation of area.

²¹ Darkwoods Tree list Methodology_Feb5-2025.docx

- A new PD deviation was made in the 2022-2023 monitoring period to calculate reductions and removals using *VT0015 Calculation of Reductions and Removals for VM0003, VM0005, VM0012, and VM0034, v1.0*. The deviation does not impact the applicability of the methodology, additionality, or the appropriateness of the baseline scenario. The resulting calculations can be found in Appendix 3 and the supporting quantification spreadsheet²².

2.2.6 Grouped Projects (VCS, 3.6; CCB, G1.13-G1.15, G4.1)

N/A. This is not a grouped project.

2.2.7 Risks to the Project (CCB, G1.10)

Identified Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Fire	Large, high intensity fires have the potential to push forest biodiversity outside the range of natural variability. Large high intensity fires release large amounts of stored carbon and can reduce the capacity of the ecosystem to sequester carbon due to soil degradation and attenuation of ecosystem resilience.	The Property Area is access controlled (which mitigates and limits any potential human-induced risks), and local NCC staff are regularly on the property to monitor project activities and natural disturbance conditions. In addition to observation by NCC staff, contractors, and other users of the property during day-to-day activities, NCC has undertaken at least one observation helicopter flight over the property per year to survey for unexpected impacts from pests, disease, extreme weather, and/or fire. Additional over-flights have been undertaken seasonally, or in reaction to heavy storms, high fire conditions, or other reasons periodically on the property as needed.
Pests and Disease	Insect epidemics can alter the ecology and natural succession of the forest and result in reductions in forest biodiversity and affect biomass stocks.	
Extreme Weather	Extreme weather events have the potential to impact ecosystems, alter habitats, and affect biomass stocks.	

²² VT0015_Darkwoods VCS607_v2022-v2023_24.11.2025.xlsx

During daily and helicopter observations during this monitoring period, no material areas of pest or disease beyond normal endemic levels were identified. Also, no material areas of forest damage due to extreme weather was noted beyond normal and expected levels of individual tree blowdown.

The property was subject to three fires in 2022 totalling ~702 ha and four fires in 2023 totalling ~2 ha, which is generally consistent with the expected return interval for fire in the risk assessment outlined in the VCS AFOLU Non-Permanence Risk Tool. The project's fire detection and fire-fighting processes worked successfully as expected to contain the fires. Additionally, the forest within the fire-affected area for the 2021 event (for which a loss report was submitted) continued to respond to the effects of the fire into vintage 2022. This was reported by BC Ministry of Forests (MOF) in 2022, when they updated burn severity ratings that were initially described in 2021 (and included in the carbon calculations from the previous monitoring period) using remote sensing images collected in July 2022. Fire severity mapping from the fires that occurred during the monitoring period and the associated impacts on carbon stocks that occurred within 2022 as a result of the 2021 fire event are all included in emission calculations within this monitoring period.

No other risks to the project occurred during this monitoring period.

2.2.8 Benefit Permanence (CCB, G1.11)

The Darkwoods project is based around the conservation of the property in perpetuity and no additional measures were necessary to maintain or enhance the climate, community, and biodiversity benefits during this monitoring period.

2.3 Stakeholder Engagement & Safeguards

2.3.1 Stakeholder Identification (VCS, 3.18, 3.19; CCB, G1.5)

N/A.

There has been no change to stakeholders during this monitoring period.

2.3.2 Stakeholder Access to Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

NCC has an open and constant engagement policy with interested stakeholders related to the Darkwoods project and other NCC initiatives in the region. NCC is publicly known throughout the region, and any person wanting to comment can do so through phone, social media, website contacts, or direct interaction at the local NCC offices.

During this monitoring period, NCC maintained webpages specific to Darkwoods and the Darkwoods Carbon Project²³.

Project documentation is also publicly available on the Verra Registry.

2.3.3 Dissemination of Summary Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

During this monitoring period, NCC maintained webpages specific to Darkwoods and the Darkwoods Carbon Project²⁴.

Darkwoods is located in a fully developed region with almost ubiquitous daily internet access, and therefore the primary form of project information distribution is through the NCC project webpages. Project implementation and Project Area activities are also communicated through meetings with key stakeholders. A non-exhaustive list of stakeholder meetings during the monitoring period is shown in Section 2.3.4. NCC has not identified particular newly affected stakeholders to whom documentation is to be directly distributed; however, NCC is willing to provide documentation should any stakeholders request it.

2.3.4 Informational Meetings with Stakeholders (VCS, 3.18, 3.19; CCB, G3.1)

Several informational meetings were held throughout the monitoring period. Where relevant to communities and other stakeholders, those events were publicized as described below.

Date	Event/Engagement Type	Topic	Public Sharing
Nov 20, 2023	Donation of ponderosa pine seeds from Darkwoods Project to Osoyoos Indian Band	Seeds used for post fire restoration projects in a portion of OIB reserve and traditional territory in the public lands east of Osoyoos and Oliver	Not publicized, not relevant to broader community and other stakeholders.
Nov 15, 2023	Discussion with Okanagan Nation Alliance	Discussed whitebark restoration collaboration with Lindy Lin (ONA)	Not publicized, not relevant to broader community and other stakeholders.
Nov 07, 2022	Public Outreach - speaker, panel, lecture	South Selkirks - Lower Columbia Conservation Action Forum. Darkwoods fire management	Public event organized and publicized by the Kootenay Conservation

²³ <https://www.natureconservancy.ca/en/what-we-do/nature-and-climate/dw-carbon.html>

²⁴ <https://www.natureconservancy.ca/en/where-we-work/british-columbia/featured-projects/west-kootenay/darkwoods/>

			Program on their e-blasts and website.
May 26, 2023	Field tour of Darkwoods with the Okanagan Nation Alliance Invitations were sent to other Nations, but representatives were unavailable at that time.	Management of fire, carbon, species, and ecosystems were discussed. Agreed to follow up with more field tours, info sharing and looking for collaboration opportunities	Personal, direct invitations to community members.
Sept 23, 2022	Public Outreach – Presentations (not science)	Keynote	Public event organized and publicized by the Kootenay Conservation Program on their e-blasts and website
June 15, 2022	Technical Project Planning Workshop - webinar	Ecosystem Restoration Project workshop - Darkwoods Whitebark Restoration	Public webinar organized and publicized by Columbia Basin Trust through their various communication channels
Sept 27 2022	Notification letters sent	Letters notified nations (KNC, ONA) of the carbon public comment period of Darkwoods	Not publicized. Letters sent to Nations directly.

2.3.5 Risks from the Project and No Net Harm (VCS, 3.18, 3.19)

There are no individuals, communities, Indigenous people or public users that derive income or are dependent on the Property Area. The project activities did not cause any risk in this monitoring period.

2.3.6 Community Costs, Risks, and Benefits (CCB, G3.2)

Areas of interest and development on this project that could and have provided benefits to communities include:

- Enhanced the community amenity values for the local region, including
 - non-motorized recreational and backcountry use via a permit system,
 - continued to support hunting activities,
 - supported scientific research and projects of value to the region and communities,
 - continued visual benefits for the surrounding areas and communities
 - and supporting regional environmental values and issues.

NCC bears all cost and decision-making regarding the carbon project, and this has not changed in this monitoring period.

2.3.7 Information to Stakeholder on Verification Process (VCS, 3.18.6, 3.19; CCB, G3.3)

Stakeholders in the project zone are fully modern with virtually the entire population has daily online access and extensive usage of internet resources. Therefore, as for previous verifications, NCC placed a prominent posting on the Darkwoods website with a link to the VCS/CCB comment website and posted notifications on major social media sites. No comments were received.

2.3.8 Site Visit Information and Opportunities to Communicate with Auditor (VCS, 3.18.6, 3.19; CCB, G3.3)

A letter was sent to First Nation stakeholders informing them of the audit and providing additional contact information for the VVB to enable communication. Stakeholders and community members selected for interviews by the VVB were notified by NCC of the site visit directly. NCC also provided public notification of the VVB site visit to all other communities and stakeholders via the Darkwoods carbon project website, including contact information for the VVB.

2.3.9 Stakeholder Consultation (VCS, 3.18; CCB, G3.4)

Information regarding stakeholders and stakeholder consultation has remained in line with the VCS/CCB PD. The methods of stakeholder consultation have not changed during this monitoring period. Section 2.3.4 outlines the record of engagement during the monitoring period.

Ongoing Consultation	NCC has an open and constant engagement policy with interested stakeholders related to the Darkwoods project and other NCC initiatives in the region. NCC is publicly known throughout the region, and any person wanting to comment can do so through phone, social media, website contacts, or direct interaction at the local NCC offices.
Date(s) of stakeholder consultation	See table from Section 2.3.4 for exact dates.

Communication of monitored results	During this monitoring period, NCC maintained webpages specific to Darkwoods and the Darkwoods Carbon Project²⁵. Darkwoods is located in a fully developed region with almost ubiquitous daily internet access, and therefore the primary form of project information distribution is through the NCC project webpages. Project implementation and Project Area activities are also communicated through meetings with key stakeholders. A non-exhaustive list of stakeholder meetings during the monitoring period is shown in Section 2.3.4. NCC has not identified particular newly affected stakeholders to whom documentation is to be directly distributed; however, NCC is willing to provide documentation should any stakeholders request it. The monitoring results from previous verifications are also included in the previous monitoring reports which are posted on the Verra Registry.
Consultation records	All information regarding stakeholder consultation is captured and tracked by NCC in the Land Resource Manager (LRM).
Stakeholder input	Generally, NCC receives concerns via phone or an in-person visit, to which the concern is then addressed in person. NCC will typically respond to written concerns with a written response as soon as possible. If a concern cannot be resolved between an Indigenous Nation or community member and NCC, a third-party mediator can be engaged if needed. Concerns submitted to NCC are first documented at a local level and any notable or unresolved concerns are brought to the attention of the regional office which will deal with the concern accordingly. The BC Regional Office with delegated authority from the NCC National Office is the final authority for responding to any issues related to Darkwoods. All concerns and communications are tracked by NCC in the Land Resource Manager. This will be shared with the auditors directly and is considered personal and sensitive information that will not be made public as NCC values individual's privacy and does not share this type of information in a public space unless additional approvals have been provided.

²⁵ <https://natureconservancy.ca/what-we-do/nature-and-climate-accelerator/darkwoods-forest-carbon-project>

	No specific conflicts or grievances related to Darkwoods project implementation have been noted during this monitoring period, and as such, there have been no updates to the project design.
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2.3.10 Continued Consultation and Adaptive Management (VCS, 3.18; CCB, G3.4)

Continued consultation and adaptive management in this monitoring period is to continue as is outlined in the VCS/CCB PD Section 2.3. No further comments have been received during this monitoring period and, therefore, no actions have been taken.

Summary of comments received	Actions taken
No comments received	No comments received

2.3.11 Stakeholder Consultation Channels (CCB, G3.5)

NCC has remained in communication with communities and other stakeholders identified since project inception. Stakeholder consultation communications are tracked through the Land Resource Manager (previously named Land Information System) and this has not changed during this monitoring period.

2.3.12 Stakeholder Participation in Decision-Making and Implementation (VCS, 3.18, 3.19; CCB, G3.6)

NCC is the sole decision-making authority regarding the carbon project, however, NCC has continued to engage with Indigenous Nations regarding additional benefits that may arise in the Property Area over time. Feedback from Indigenous Peoples has focused on land access, and traditional use of the property.

2.3.13 Anti-Discrimination Assurance (VCS, 3.19; CCB, G3.7)

NCC recognizes and adheres to the laws and legislation surrounding human rights in BC and Canada. NCC does not discriminate nor tolerate discrimination in any form, and measures were carried out throughout the project design and implementation stages to ensure that the other entities involved in the project are not complicit in discrimination or sexual harassment of any kind. These measures exist in the form of NCC's internal human resources policies, which govern the management and conduct of NCC's employees^{26,27}. These policies include information pertaining to discrimination and related reporting and management practices. All employees are required to comply with these policies, which are reviewed and updated by senior management on an annual basis.

2.3.14 Grievances (VCS, 3.18.4; CCB, G3.8)

NCC is highly transparent, and anyone from the public can contact the organisation through multiple avenues, such as:

- Offices with knowledgeable staff in the BC Region and at NCC's national office in Toronto, Ontario
- NCC's website including address, phone number and email contact info for each BC based office
- NCC's website's general "contact us" function
- The Darkwoods carbon project website.

Generally, NCC receives concerns via phone or an in-person visit, to which the concern is then addressed in person. NCC will typically respond to written concerns with a written response as soon as possible. If a concern cannot be resolved between an Indigenous Nation or community member and NCC, a third-party mediator can be engaged if needed.

Concerns submitted to NCC are first documented at a local level and any notable or unresolved concerns are brought to the attention of the regional office which will deal with the concern accordingly. The BC Regional Office with delegated authority from the NCC National Office is the final authority for responding to any issues related to Darkwoods.

All concerns and communications are tracked by NCC in the Land Resource Manager. This will be shared with the auditors directly and is considered personal and sensitive information that will not be made public as NCC values individuals' privacy and does not share this type of information in a public space unless additional approvals have been provided.

No specific conflicts or grievances related to Darkwoods project implementation have been noted during this monitoring period.

²⁶ The Nature Conservancy of Canada Management Policy: Human Resources Policy (2020)

²⁷ NCC Boreal Wildlands Occupational Health & Safety Program (2022)

Grievances received	Resolution and outcome
No grievance received	N/A

2.3.15 Worker Training (VCS, 3.19; CCB, G3.9)

NCC outlines orientation and training processes in: The Nature Conservancy of Canada Management Policy: Human Resources Policy (2020) and the NCC Health, Safety and Environmental Policy (2022). NCC also provides ongoing worker training on a wide variety of conservation issues including specialized attention to marginalized and vulnerable people through staff conferences, guest speakers, and formalized training modules. The only local employee is the Darkwoods Manager, who is a Registered Professional Biologist in good standing with the BC College of Applied Biologists where continuing professional development activities is a requirement and must be reported annually to the College.

Local capacity is maintained through the ongoing use of local contractors for all work performed on Darkwoods. Table 7 shows all of the contractors hired during this monitoring period.

Table 7. Contractors hired during the monitoring period

Contractors hired during this Monitoring Period
SNT Engineering (Nelson, BC): Assessed and designed bridges
Wildhorse Forestry (Ymir, BC): Planted endangered whitebark pine
EcoSense Silviculture (Creston, BC): Thinned overstocked stands
DGH Contracting (Castlegar, BC): Brushed roadsides
Custom Dozing (Salmo, BC): Maintained and deactivated roads
Central Kootenay Invasive Species Society (Nelson, BC): Monitored and controlled invasive weeds
PRT (Procter, BC and Nupqu - Cranbrook, BC): Contracted to grow seedlings for tree planting projects
Leslie Resource Consulting (Nelson, BC): Forest thinning prescriptions.
Phoenix Harvesting (Nelson, BC): Completed harvest
Woodberry Wildland (Kaslo, BC): Danger tree faller
Chil Logging (Cranbrook, BC): Completed 1st harvest
Loss Creek Logging (Creston, BC): Completed 2nd harvest

Masse Environmental Consultants (Nelson, BC): Bridge removal environmental services
Herzig Construction (Ymir, BC): Completed cabin repairs in Tye
Sylvan Vale Nursery Ltd (Black Creek, BC): Grew Whitebark pine seedlings

2.3.16 Community Employment Opportunities (VCS, 3.19.13; CCB, G3.10)

During the monitoring period, NCC continued to employ one full-time site supervisor, along with a constant level of regional and national staffing related to Darkwoods. Contractors from the local community were hired seasonally to complete specific tasks (e.g. tree planting, road repairs, invasive species treatments, etc.). Staff and contractor selection is monitored through NCC's HR and accounting departments and must adhere to the previously referenced policies regarding discrimination and equitable hiring.

2.3.17 Occupational Safety Assessment (VCS, 3.19; CCB, G3.12)

Darkwoods project activities are typical operations for forestry operations and timberland in BC, and include typical forest operations (logging, road work, etc.) and various forest field work. There are no unusual or unique activities, and therefore risks are typical of operations undertaken commonly across the forest industry.

In Canada, all third-party contractors operate as “independent contractors”, a specific legal term that requires the contractors to operate and direct their delivery of services and employees independently. Therefore, operational safety procedures are the purview of each contractor. The WorkSafe BC regulations and BC Forest Safety Council SAFE Company programs are the primary methods in BC to assure worker safety in the forest industry and include training and procedural materials used across the industry. Various levels of performance are self-audited by these programs.

NCC's policies related to health and safety, including safe operating procedures, are fully documented in: Health, Safety and Environmental Policy (2018). As per this document and other NCC annual plans, employees undergo various health and safety awareness and training programs, as applicable to their job function.

NCC contracts mandate that all contractors have a valid and active WorkSafe BC number. The contractor is then responsible to WorkSafe BC²⁸ to ensure that legal regulations are followed.

²⁸ <https://www.worksafebc.com/en/about-us/who-we-are/missionvision-values>

NCC undertakes pre-work reviews with contractors as described in the NCC Darkwoods Occupational Health & Safety Program, which includes a pre-work safety site orientation checklist. NCC also ensures that logging contractors and other large contractors have at least equivalent procedures. Researchers are made aware of safety issues through both a research permit and waiver. And finally, general public access permits are also advised of the risks on the permits document.

For this monitoring period, no material new or unique employee or contractor worker health and safety risks were created, and the existing NCC, government, and industry policies were implemented as designed to inform workers and mitigate safety risks as per industry best practices.

2.4 Management Capacity

2.4.1 Required Technical Skills (VCS, 3.19; CCB, G4.2)

NCC has retained or improved its regional and national expertise in biodiversity management, carbon measurement and monitoring, and community engagement throughout this monitoring period. Specific skillsets required to implement the project include: - Communication and stakeholder engagement - Biodiversity assessment & planning - Forest management & planning - Carbon measurement & monitoring - Project management - Finance and business management - Carbon sales and marketing - Data analysis (including GIS, Inventory, forest and carbon modeling).

2.4.2 Management Team Experience (VCS, 3.19; CCB, G4.2)

Table 8 documents the management team's expertise and prior experience implementing land management and carbon projects at the scale of this project.

Table 8: NCC management Experience

Contact	Company	Title	Project Responsibilities	Related Skillsets
Craig Losos	Nature Conservancy of Canada	Executive Director, Nature + Climate Projects Accelerator, National Office	Craig Losos joined The Nature Conservancy of Canada (NCC) in fall 2021 to lead the new Nature + Climate Projects Accelerator (N+CPA Accelerator) group. This team will leverage innovative finance tools toward furthering NCC's core conservation mission. NCC and the Accelerator offer a unique	Stakeholder engagement Finance and business management

			vehicle to deliver exciting conservation work combined with nature-based solutions and positive climate outcomes.	
Rob Wilson	Nature Conservancy of Canada	Director – Conservation Finance	Rob Wilson joined The Nature Conservancy of Canada (NCC) in 2007, and is currently the director of conservation finance at NCC. He advises on NCC's conservation finance-related programs that support NCC's nature-based, natural climate solutions work, with a particular focus on carbon finance. In particular, he has been involved for more than a decade in the development and management of the Darkwoods project, and more recently in the Boreal Wildlands carbon project in Ontario.	Stakeholder engagement Project management Carbon Sales and marketing Finance and business management
Julia Windeler	Nature Conservancy of Canada	Project Manager, Nature + Climate Projects Accelerator	Julia Windeler joined NCC's Nature + Climate Projects Accelerator team in 2022 and has been acting as the project manager for NCC's carbon project verifications and validations since October 2023. Julia holds a Masters of Science in Climate Science & Policy from King's College London.	Project management Contractor management Carbon sales and marketing Partnership management

Nancy Newhouse, RPBio	Nature Conservancy of Canada	Regional Director, BC	Regional manager with direct oversight of Darkwoods operations, regional stakeholder engagement, and project monitoring activities, etc. Project relevant skillset/experience include: biological sciences, biodiversity planning and monitoring, team leadership, staffing, project management support, and managing regional community and stakeholder engagement.	Stakeholder engagement Project management Biodiversity assessment and planning
Adrian Leslie, RPBio	Nature Conservancy of Canada	West Kootenay Project Manager	Darkwoods operational management including project monitoring activities and many aspects of stakeholder engagement. Project relevant skillset/experience include: biology and forestry expertise, operational management, project management, monitoring management, and local community/stakeholder engagement.	Stakeholder engagement Project management Biodiversity assessment and planning Forest management and planning Carbon measurement and monitoring Data analysis (GIS, inventory, etc.)
Trevor Reid	Nature Conservancy of Canada	Director of Planning and Innovation	Carbon project monitoring, project management and reporting. Leads carbon project modeling, documentation, and reporting at each monitoring period.	Project Management Forest management and planning Carbon measurement and monitoring Data analysis (GIS, inventory, forest and carbon modeling, etc.)

In addition, NCC engages with other internal and external technical experts as needed to support additional data collection, data analysis, research, planning or any other supporting functions required at Darkwoods. This includes project implementation partners Ostrom Climate.

2.4.3 Project Management Partnerships/Team Development (VCS, 3.19; CCB, G4.2)

Carbon project design, reporting, and related advisory services and expertise are provided by Ostrom Climate to NCC. Operationally, the monitoring for all elements of the carbon project is undertaken by BC Regional staff, primarily headed by the Darkwoods Site Manager. Ostrom Climate handles all carbon project data analysis and modeling (in conjunction with NCC GIS staff), complies project reporting, and provides technical oversight and advice to the project on an ongoing basis. Ostrom Climate's team bios are provided to the VVB. Any other professional expertise necessary are filled by contractors listed in Table 7.

2.4.4 Financial Health of Implementing Organization(s) (CCB, G4.3)

The Nature Conservancy of Canada is Canada's largest not-for-profit land trust organization with a 60-year history of financial stability. NCC's financial statements are publicly available²⁹.

NCC has remained financially stable during this monitoring period, and the Darkwoods project has been fully funded, including the generation of significant carbon finance revenue from VCU sales.

2.4.5 Avoidance of Corruption and Other Unethical Behavior (VCS, 3.19; CCB, G4.3)

The Nature Conservancy of Canada is a prominent national not-for-profit organization that complies with the laws and regulations of Canada and British Columbia, including those pertaining to corruption, etc. NCC maintains well-developed internal human resources policies governing the management and conduct of NCC's employees: See the Nature Conservancy of Canada Management Policy: Human Resources Policy³⁰ and supporting documentation.

There have been no changes to this policy or issues related to it during this monitoring period.

2.4.6 Commercially Sensitive Information (VCS, 3.5.2-3.5.4; CCB Program Rules, 3.5.13 – 3.5.14)

Any commercially sensitive information has been provided to the VVB.

²⁹ www.natureconservancy.ca/en/who-we-are/annual-reports

³⁰ The Nature Conservancy of Canada Management Policy: Human Resources Policy (2012).

2.5 Legal Status and Property Rights

2.5.1 National and Local Laws (VCS, 3.1, 3.6, 3.7, 3.14, 3.18, 3.19; CCB, G5.6)

No changes to the laws relevant to the project have been implemented in this monitoring period, and the project remains in compliance with all laws as per the CCB PD.

2.5.2 Relevant Laws and Regulations Related to Worker's Rights (VCS, 3.18, 3.19; CCB, G3.11)

Canada has very well-developed labour legislation governing workers' rights. Responsibility for the establishment of labour legislation generally falls under provincial jurisdiction, along with federal authority in certain industries. This legislation governs minimum employment standards that by law define and guarantee workers' rights within the workplace. Each province, as well as the federal government, has legislation governing workplace health and safety, as all Canadian workers have the right to work in a healthy and safe environment. Human rights provisions, fair employment practices and equal pay and anti-discrimination laws are covered under federal and provincial human rights and labour legislation.

In British Columbia, the B.C. Ministry of Labour, Employment Standards Branch is responsible for the administration of the provincial Employment Standards Act. This Act covers the following topic areas: Minimum Wage, Minimum Daily Pay, Meal Breaks, Paydays and Payroll Records, Overtime, Averaging Agreements, Uniforms & Special Clothing, Deductions, Statutory Holidays, Employing Young People Under 15, Compensation for Length of Service, Annual Vacation, Vacation Pay, Leave from Work, Temporary Foreign Workers, Collective Agreements and Resolving Disputes.

The Nature Conservancy of Canada has well-developed internal human resources policies governing the management of NCC's employees. The overarching Human Resources Policy is reviewed annually by senior NCC management and updated when deemed necessary. All NCC employees are informed of the existence of this policy on NCC's intranet website, which addresses the standards, requirements and procedures governing an employee's employment by NCC. All new employees are required to sign a disclosure indicating agreement and adherence to these policies and all NCC employees must renew this agreement on an annual basis.

Subcontractors, defined as service providers who bill NCC for their services, must sign an Agreement for Services contract, the standard template of which includes a separate provision entitled Compliance with Laws and Policies, as follows: "The Contractor shall be knowledgeable of and comply with the provisions of all applicable legislation, By-Laws of local authorities and Regulations in the Province of British Columbia and shall specifically ensure that the Contractor and his/her/its employees are knowledgeable of and performs all obligations imposed by the Occupational Health and Safety Act or equivalent in the Province of British Columbia".

In summary, NCC is a national organization fully compliant with the laws and regulations of BC and Canada. NCC employment policies and worker guidelines are documented in the latest versions of: The Nature Conservancy of Canada Management Policy: Human Resources Policy (2020) and the NCC Health, Safety and Environmental Policy (2022).

2.5.3 Human Rights (VCS, 3.19)

Canada has very well-developed labour legislation governing workers' rights. Responsibility for the establishment of labour legislation generally falls under provincial jurisdiction, along with federal authority in certain industries. This legislation governs minimum employment standards that by law define and guarantee workers' rights within the workplace. Each province, as well as the federal government, has legislation governing workplace health and safety, as all Canadian workers have the right to work in a healthy and safe environment. Human rights provisions, fair employment practices and equal pay and anti-discrimination laws are covered under federal and provincial human rights and labour legislation.

In British Columbia, the B.C. Ministry of Labour, Employment Standards Branch is responsible for the administration of the provincial Employment Standards Act. This Act covers the following topic areas: Minimum Wage, Minimum Daily Pay, Meal Breaks, Paydays and Payroll Records, Overtime, Averaging Agreements, Uniforms & Special Clothing, Deductions, Statutory Holidays, Employing Young People Under 15, Compensation for Length of Service, Annual Vacation, Vacation Pay, Leave From Work, Temporary Foreign Workers, Collective Agreements and Resolving Disputes.

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NCC continues to commit to recognizing, respecting and promoting the rights of Indigenous communities by creating and maintaining meaningful relationships and working alongside Indigenous communities over the last several decades. Over the decades, NCC has gained a wealth of knowledge and new points of view from Indigenous communities, which has allowed NCC to generate new and improved approaches for becoming better caretakers of the land³¹. Through the Indigenous Conservation Engagement Framework ³², NCC has renewed its commitment to building meaningful relationships with Indigenous communities by identifying how to engage more effectively with Indigenous communities and nations across Canada. NCC has also continued to progress Indigenous conservation partnerships across Canada, and has identified five areas of focus to advance such partnerships³³. NCC continues to recognize, respect, and promote the protection of human rights, and this is demonstrated through the project welcoming and encouraging accessibility to the Property Area for local Indigenous communities for traditional and cultural purposes, with a view to creating even more opportunities for Indigenous communities to make use of and co-manage these lands along with NCC wherever possible. NCC has also continued to send letters to Indigenous communities in proximity to the Darkwoods Project Area, which details that the project will be undergoing verification and that a site visit may be occurring, and provides contact information for the VVB which encourages communities to provide any feedback and input on the Project. NCC also provides notice of site visits by the VVB on the Darkwoods website, and provides details on how the Indigenous communities can speak directly to the VVB.

Furthermore, NCC continues to embrace an open and constant engagement policy with Indigenous communities and other local communities related to the Darkwoods project. NCC is continuing to work with the Ktunaxa Nation on the development of an Indigenous Protected and Conserved Area (IPCA) in a portion of their traditional territory, which discussions beginning in 2020 and continuing through this monitoring period. Additionally, Darkwoods sits on the unceded territories of two other First Nations, the Sinixt and Sylix Okanagan Nations, and has continued to form growing and deepening relationships with these local First Nations which has resulted in increased collaboration and communication during this monitoring period. NCC is currently working on formalizing an access agreement with the local First Nations band, the Yaqan Nukiy, which is part of the Ktunaxa Nation. NCC has provided the Yaqan Nukiy with a key to the Darkwoods property gates so that they can continue with traditional land use activities on their unceded territory. It is a positive and growing relationship built on trust and respect.

³¹ <https://www.natureconservancy.ca/en/who-we-are/publications/magazine/fall-2022/walking-together-on-the-land.html>

³² https://www.natureconservancy.ca/assets/documents/nat/NCC_ICEF-2023.pdf

³³ <https://www.natureconservancy.ca/en/what-we-do/indigenous-conservation/>

NCC is a national organization fully compliant with the laws and regulations of BC and Canada. NCC employment policies and worker guidelines are documented in the latest version of: The Nature Conservancy of Canada Management Policy: Human Resources Policy (2020).

There have been no changes to this policy or compliance during this monitoring period.

2.5.4 Indigenous Peoples and Cultural Heritage (VCS, 3.18, 3.19)

The Darkwoods Project continues to preserve and protects cultural heritage in the form of traditional practices and knowledge-sharing by promoting and renewing Indigenous access to the land. Through ongoing discussions, NCC hopes to incorporate Indigenous ways of knowing into the land management plan. NCC is aware of cultural sites on the Darkwoods property, but does not have them mapped nor share their location with anyone to respect the wishes of the First Nation. These sites are not compromised by the project activities.

2.5.5 Recognition of Property Rights (VCS, 3.7, 3.18, 3.19; CCB, G5.1)

Disputes over rights to territories and resources	N/A, no disputes occurred.
Respect for property rights	The Darkwoods property is private forestland, as outlined in the PD, and does not include any permanent habitation or community activities, and as such the project does not require any relocation or exclusion of communities.

2.5.6 Benefit Sharing Mechanism (VCS, 3.18, 3.19)

Summary of the benefit sharing plan	Project Area sits on fee simple private land, so the Project does not impact property rights. Therefore, no benefit sharing mechanism exists.
Benefit sharing during the monitoring period	Project Area sits on fee simple private land, so the Project does not impact property rights. Therefore, no benefit sharing mechanism exists.

2.5.7 Free, Prior, and Informed Consent (VCS, 3.18, 3.19; CCB, G5.2)

Not applicable - as fee simple private land, the registered title documents accord all aspects related to surface rights to NCC. The Property Area does not contain or involve any areas not privately owned by NCC.

2.5.8 Property Right Protection (VCS, 3.18, 3.19; CCB, G5.3)

Not applicable - the Darkwoods property is private forestland and does not include any permanent habitation or community activities, and as such the project does not require any relocation or exclusion of communities.

2.5.9 Identification of Illegal Activity (VCS, 3.19, CCB, G5.4)

No illegal activities have occurred on the Property Area during this monitoring period.

Canada has strictly governed and enforced forest protection laws. BC's Forests and Range Practices Act³⁴ outlines laws and regulations around illegal activities such as trespassing and timber theft. The BC Wildlife Act³⁵ and BC Species at Risk Act³⁶ prohibit any illegal wildlife poaching that could occur on the project land. Law enforcement is carried out by the BC Provincial Police and BC Conservation Officers.

Furthermore, Canada and BC have stringent labour legislation in place which covers issues such as the use of victims of human trafficking, forced labour, and child labour (see Section 2.5.3). NCC complies entirely with this.

2.5.10 Ongoing Disputes (VCS, 3.18, 3.19; CCB, G5.5)

No disputes related to the project exist.

3 CLIMATE

3.1 Monitoring GHG Emission Reductions and Removals

3.1.1 Data and Parameters Available at Validation (VCS, 3.16)

Data / Parameter	ABSL _i
Data unit	Ha
Description	Respective areas of baseline and project polygon, i

³⁴ <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/forest-range-practices-act>

³⁵ <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/wildlife-act>

³⁶ <https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/environmental-management/reference-documents/environmental-regulatory-compliance/species-at-risk-federal-provincial>

Source of data	NCC Darkwoods GIS spatial inventory data (2021 LiDAR EFI) - Baseline datasets
Value applied	Inventory polygon GIS hectares
Justification of choice of data or description of measurement methods and procedures applied	The method of mapping inventory polygons, identified as homogenous forest management units, is justified as it is based on standard British Columbia inventory methods as outlined in “Inventory Data Collection Standards for VRI Ground Sampling Version 2.1” which can be found at: https://www.for.gov.bc.ca/hts/risc/alphastand.htm
Purpose of data	Required for calculation of baseline and project emissions
Comments	The parameter $A_{PRJ,t}$ is the same as $A_{BSL,t}$ with the exception of 2008-2011 baseline harvest polygons which are manually clipped into the baseline dataset (creating new polygons in these areas)

Data / Parameter	ΔC_t
Data unit	t C yr ⁻¹
Description	The annual carbon balance in the baseline or project scenario for year, t. See Equation 57
Source of data	Calculated following Equation 57 within the Darkwoods Carbon Database and Darkwoods Carbon Model using FVS_FFE Stand Carbon Report outputs. Calculated from Equation 1 and Equation 29; with subscript BSL and PRJ, respectively.
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculating gross emission reductions ($ER_{y, GROSS}$)
Comments	

Data / Parameter	$\Delta C_{P,t}$
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Data unit	t C yr ⁻¹
Description	The annual change in carbon stocks in all pools in the baseline or project scenario across the project activity area for year, <i>t</i>
Source of data	Calculated within the Darkwoods Carbon Database using FVS_FFE Stand Carbon Report outputs, and following Equation 2 and 29, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	
Comments	Calculation of $\Delta C_{t,t}$

Data / Parameter	$\Delta C_{LB,t}$
Data unit	t C yr ⁻¹
Description	The annual change in carbon stocks in living tree biomass (above- and belowground) for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Stand Carbon Report outputs and following Equation 3 and 31, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{P,t}$
Comments	

Data / Parameter	$\Delta C_{DOM,t}$
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Data unit	t C yr ⁻¹
Description	The annual change in carbon stocks due to dead organic matter for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs and following Equation 10 and 38, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{P,t}$
Comments	

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, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report and Harvest Product Report outputs, following Equation 18 and 47, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{P,t}$
Comments	Fossil fuel emissions from equipment and manufacturing are made within the Darkwoods Carbon Model using harvest volume outputs from FVS-FFE and FPS

Data / Parameter	$\Delta C_{G,t}$
Data unit	t C yr ⁻¹
Description	The annual change in carbon stocks due to live biomass gain for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs, which incorporate Equations 5a-5b and 33a-33b, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{LB,t}$
Comments	

Data / Parameter	$\Delta C_{L,t}$
Data unit	t C yr ⁻¹
Description	The annual change in carbon stocks due to live biomass loss for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs, which incorporate Equations 7-9 and 35-37, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{LB,t}$

Comments	
Data / Parameter	$\Delta C_{LDW,t}$
Data unit	t C yr ⁻¹
Description	The annual change in lying dead wood carbon stocks for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs, which incorporate Equations 11b-13 and 39b-41, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario.
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{DOM,t}$
Comments	
Data / Parameter	$\Delta C_{SNAG,t}$
Data unit	t C yr ⁻¹
Description	The annual change in standing dead wood carbon stocks for year, <i>t</i>
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs, which incorporate Equations 14b-16 and 42b-44, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively

Purpose of data	Calculation of $\Delta C_{DOM,t}$
Comments	

Data / Parameter	$\Delta C_{DBG,t}$
Data unit	t C yr ⁻¹
Description	The annual change in dead belowground carbon stocks for year, t
Source of data	Calculated by FVS-FFE and compiled within the Darkwoods Carbon Database using FVS_FFE Carbon Report outputs, which incorporate Equations 17b-17d and 45b-45d, for the BSL and PRJ, respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Best available data from FVS_FFE model output, used in the calculation of baseline and project emissions, respectively
Purpose of data	Calculation of $\Delta C_{DOM,t}$
Comments	

Data / Parameter	CF
Data unit	t C t ⁻¹ d.m.
Description	Carbon fraction of dry matter
Source of data	IPCC 2006, (Penman and others, 2003), (Smith and Heath, 2002)
Value applied	0.5 applied in FVS to living and dead biomass
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value with broad support in published work
Purpose of data	Required for calculation of baseline and project emissions
Comments	

Data / Parameter	R _i
Data unit	unitless
Description	Root Biomass
Source of data	Jenkins and others (2003)
Value applied	BgL carbon pool in FVS
Justification of choice of data or description of measurement methods and procedures applied	Jenkins estimates are used by FVS-FFE for live and dead root biomass
Purpose of data	Required for calculation of baseline and project emissions
Comments	

Data / Parameter	BEF
Data unit	unitless
Description	Biomass expansion factors for conversion of productivity metrics to biomass
Source of data	Modeled by FVS-FFE (FVS CRM setting)
Value applied	FVS-FFE default settings for the IE Variant. Based on the Volume Estimator Library Equations (2009) as developed and maintained by the USFS Forest Products Measurement Group in the Forest Management Service Center
Justification of choice of data or description of measurement methods and procedures applied	FVS-FFE is widely used, meets the VM0012 modeling requirements, and is calibrated to the Project Area in the IE Variant
Purpose of data	Required for calculation of baseline and project emissions
Comments	

Data / Parameter	fBRANCH,i,t
Data unit	unitless ($0 < \text{fBSL}, \text{BRANCH}_i, \text{fPRJ}, \text{BRANCH}_i, t < 1$)
Description	The annual proportion of aboveground tree biomass comprised of branches in polygon i, year t, in the baseline and project scenarios, respectively
Source of data	Calculated in FVS using regional species specific crown biomass equations based on Brown and Johnston (1976) as described in Rebas (2015)
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	FVS-FE data is widely reviewed and accepted, and the method is based on published source
Purpose of data	Required for calculation of baseline and project emissions
Comments	

Data / Parameter	fBUCKINGLOSS,i,t
Data unit	unitless ($0 < \text{fBSL}, \text{BUCKINGLOSS}_i, \text{fPRJ}, \text{BUCKINGLOSS}_i, t < 1$)
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, for the BSL and PRJ cases, respectively
Source of data	Based on (Smith, Miles, Vissage, & Pugh, 2004)
Value applied	0.10 of stemwood is assumed to be left on site
Justification of choice of data or description of measurement methods and procedures applied	The estimate is justified as it matches the PD assumptions and is based on the professional judgement of NCC field staff
Purpose of data	Required for calculation of baseline and project emissions
Comments	Applied by the YardLoss keyword in FVS.

Data / Parameter	P3-year and P100-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 , for the BSL and PRJ, respectively
Source of data	Calculated within the FVS-FFE using FVS_FFE Carbon Report and Harvested Wood output reports. FVS_FFE tracks HWP pools according to the reference Forestry Appendix of the Technical Guidelines of the US Department of Energy's Voluntary Reporting of Greenhouse Gases Program (known as Section 1605(b))
Value applied	Calculated using FVS-FFE default values for IE variant and VRI inventory data
Justification of choice of data or description of measurement methods and procedures applied	FVS_FFE utilizes the reference HWP pool tracking method referenced by VCS requirements: Forestry Appendix of the Technical Guidelines of the US Department of Energy's Voluntary Reporting of Greenhouse Gases Program (known as Section 1605(b))
Purpose of data	Reporting of Greenhouse Gases Program (known as Section 1605(b))
Comments	Required for calculation of baseline and project emissions

Data / Parameter	PBSL,SLF, PBSL,MLF, PBSL,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 ; for the BSL and PRJ, respectively
Source of data	Calculated by FVS-FFE using the FVS_FFE Carbon Report and Harvested Wood output reports. FVS_FFE natively tracks HWP pools according to the reference Forestry Appendix of the Technical Guidelines of the US Department of Energy's Voluntary Reporting of Greenhouse Gases Program (known as Section 1605(b)). This matches equations 22a-22c and 50a-50c in the baseline and project, respectively

Value applied	FVS-FFE default values for IE Variant
Justification of choice of data or description of measurement methods and procedures applied	FVS_FFE utilizes the reference HWP pool tracking method referenced by VCS requirements: Forestry Appendix of the Technical Guidelines of the US Department of Energy's Voluntary Reporting of Greenhouse Gases Program (known as Section 1605(b))
Purpose of data	Required for calculation of baseline and project emissions
Comments	

Data / Parameter	fTRANSPORT _k
Data unit	Unitless
Description	The fraction of raw material transported by transportation type, k
Source of data	NCC staff professional opinion
Value applied	Transport type truck = 1
Justification of choice of data or description of measurement methods and procedures applied	All forest products are hauled by truck
Purpose of data	n/a
Comments	Applied within the Darkwoods Carbon Model spreadsheet

Data / Parameter	CHARVEST
Data unit	t C emitted/t C raw material
Description	The carbon emission intensity factor associated with harvesting
Source of data	Zhang, Cormier, Lyng, Mabee, Ogino, & McLean (2010)
Value applied	0.016

Justification of choice of data or description of measurement methods and procedures applied	Best available data from published data sources. Default selection in VM0012 v1.2
Purpose of data	n/a
Comments	Applied within the Darkwoods Carbon Model spreadsheet

Data / Parameter	cMANUFACTURE _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	(Pingoud & Lehtila, 2002)–Calculated from Table I & III
Value applied	Sawnwood = 0.040 Plywood & Structural Panels = 0.060 Non-structural Panels = 0.120 Paper = 0.0
Justification of choice of data or description of measurement methods and procedures applied	Best available data from published data sources. Default selection in VM0012 v1.2
Purpose of data	n/a
Comments	Applied within the Darkwoods Carbon Model spreadsheet

Data / Parameter	cTRANSPORT _k
Data unit	t C emitted/t C raw material
Description	The carbon emission intensity factor associated with the transport of product k, by transport type
Source of data	(Heath, et al., 2010)-From Supporting Information Table S16
Value applied	Truck = 0.0000700

Justification of choice of data or description of measurement methods and procedures applied	Best available data from published data sources. Default selection in VM0012 v1.2
Purpose of data	n/a
Comments	Applied within the Darkwoods Carbon Model spreadsheet

Data / Parameter	dTRANSPORTk
Data unit	km
Description	The distance transported by transport type, k
Source of data	NCC field staff assumed average haul distance
Value applied	Truck = 50
Justification of choice of data or description of measurement methods and procedures applied	Local staff professional opinion
Purpose of data	n/a
Comments	Applied within the Darkwoods Carbon Model spreadsheet

Data / Parameter	CEMITTRANSPORT
Data unit	tC/yr
Description	The annual fossil fuel emissions associated with the transport of raw material, for the BSL and PRJ scenarios respectively
Source of data	Calculated within the Darkwoods Carbon Model using harvest volumes from FPS and FVS-FFE
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Best available data from published data sources. Default selection in VM0012 v1.2
Purpose of data	n/a
Comments	

Data / Parameter	GAG,i,t
Data unit	t d.m. ha ⁻¹ yr ⁻¹
Description	Annual increment rate in aboveground biomass (t d.m. ha ⁻¹ yr ⁻¹), in polygon, <i>I</i> ; for the BSL and PRJ, respectively
Source of data	Modeled and compiled by FVS_FFE by polygon based on current forest inventory
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{G,t}$
Comments	

Data / Parameter	GBG,i,t
Data unit	t d.m. ha ⁻¹ yr ⁻¹
Description	Annual increment rate in belowground biomass (t d.m. ha ⁻¹ yr ⁻¹), in polygon, <i>I</i> ; for the BSL and PRJ, respectively
Source of data	Modeled and compiled by FVS_FFE by polygon based on VRI stand inventory and LiDAR-derived tree list as input to FVS
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{G,t}$
Comments	

Data / Parameter	LBLNATURAL _{i,t}
Data unit	t d.m. yr ⁻¹
Description	Annual loss of live tree biomass due to natural mortality in polygon, i; t d.m. yr ⁻¹ ; for the BSL and PRJ, respectively
Source of data	Mortality functions modeled and compiled in FVS. (Wykoff and others (1982); Hamilton (1986). Represents calculation of Equation 7 and 35
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	
Comments	Calculation of $\Delta C_{L,t}$

Data / Parameter	LBLFELLINGS _{i,t}
Data unit	t d.m. yr ⁻¹
Description	Annual loss of live tree biomass due to commercial felling in polygon, i; t d.m. yr ⁻¹ ; for the BSL and PRJ, respectively
Source of data	Modeled by FVS_FFE based on the FPS harvest schedule or ex-post inventory updates for the baseline and project scenarios, respectively. FVS volume equations from the National Volume Estimator Library. Compiled and summarized by polygon in the

	Darkwoods Carbon Database. Represents calculation of Equation 8 and 36
Value applied	Variable. Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions. FVS utilizes a national database of tree volume that is maintained by the Forest Products Measurements Group in the Forest Management Service Center of the USFS
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	LBLOTHER _{i,t}
Data unit	t d.m. yr ⁻¹
Description	Annual loss of live tree biomass from incidental sources in polygon, i; t d.m. yr ⁻¹ ; for the BSL and PRJ, respectively
Source of data	Modeled by FVS_FFE. Uses volume equations from the National Volume Estimator Library if required. Uses FVS-FFE algorithms for fire impacts to biomass stocks. Compiled and summarized by polygon Darkwoods Carbon Database. Represents calculation of Equation 9 and 37
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	Relates to biomass changes in modeled fire or other natural disturbances

Data / Parameter	LB _{i,t}
Data unit	t d.m. yr ⁻¹

Description	Average live tree biomass in polygon, i , for year, t ; for the BSL and PRJ, respectively
Source of data	Calculated from $G_{i,t}$. Modeled and tracked by FVS-FFE and the Darkwoods Carbon Database
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$f_{BSL,NATURAL,i,t}$
Data unit	unitless; $0 \leq f_{NATURAL,i,t} \leq 1$
Description	The annual proportion of biomass that dies from natural mortality in forest type analysis unit or polygon i , year t
Source of data	Modeled and tracked by FVS-FFE, calibrated by the IE Variant
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$f_{BSL,HARVEST,i,t}$
Data unit	unitless; $0 \leq f_{BSL,HARVEST,i,t} \leq 1$
Description	The proportion of biomass removed by harvesting from polygon, i , in year, t

Source of data	Modeled and tracked by FVS-FFE
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$fBSL_{DAMAGE,i,t}$
Data unit	unitless; $0 \leq fBSL_{DAMAGE,i,t} \leq 1$
Description	The proportion of additional biomass removed for road and landing construction in polygon, i , year, t
Source of data	Modeled by FVS-FFE based on forest inventory updates in each scenario
Value applied	Typically zero, otherwise calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	The Darkwoods Property Area is generally fully roaded, and road and landing biomass are removed by forest inventory spatial stratification (i.e. road buffers). This variable is otherwise typically assumed to be included in $fBSL_{HARVEST,i,t}$ unless otherwise specified in a monitoring period

Data / Parameter	$fBSL_{BLOWDOWN,i,t}$
Data unit	unitless; $0 \leq fBSL_{BLOWDOWN,i,t} \leq 1$

Description	Modeled by FVS-FFE. Note episodic mortality such as tree blowdown is not modeled separately in FVS, however the stand mortality functions in FVS are representative of all types of individual tree mortality affecting stand density over time, and include snag fall, etc. Stand level blowdown events (>4 hectares) will be captured by updating the inventory data by monitoring on an ex-ante basis. No such large blowdown disturbances occurred in the project to date
Source of data	Within stand blowdown accounted for by FVS-FFE stand mortality and snag fall functions. >4ha blowdown events based on ex-post monitoring
Value applied	Typically zero, otherwise calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$f_{BSL,SNAGFALLDOWN,i,t}$
Data unit	unitless; $0 \leq f_{BSL,SNAGFALLDOWN,i,t} \leq 1$
Description	The annual proportion of snag biomass in polygon, i , year, t , that falls over and thus is transferred to the LDW pool. Relates to Equation 12, 14a-16 and Equation 40, 42a-44 for the BSL and PRJ, respectively
Source of data	Modeled within FVS-FFE based on species and dbh class. FVS snag fall functions are based on input by Bruce Marcot (USFS, Portland, OR, unpublished)
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$f_{BSL,lwDECAY,i,t}$
Data unit	unitless; $0 \leq f_{BSL,lwDECAY,i,t} \leq 1$
Description	The annual proportional loss of lying dead biomass due to decay, in polygon i , year, t
Source of data	Modeled within FVS-FFE. Default decay rates are based on Abbott and Crossley (1982)
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$f_{BSL,SWDECAY,i,t}$
Data unit	unitless; $0 \leq f_{BSL,SWDECAY,i,t} \leq 1$
Description	The annual proportional loss of snag biomass due to decay, in polygon, i , year, t
Source of data	Modeled within FVS-FFE. Default decay rates are based on Abbott and Crossley (1982)
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$SNAG_{BSL,i,t}$
Data unit	t d.m. yr ⁻¹
Description	The total amount of snag mass in polygon <i>i</i> , year, <i>t</i>
Source of data	Modeled within FVS-FFE. Reported in the Stand Carbon Report, Standing Dead
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$DBG_{i,t}$
Data unit	t d.m. yr ⁻¹
Description	The total quantity of dead belowground biomass accumulated in polygon <i>i</i> since the project start; t biomass
Source of data	Modeled within FVS-FFE. Reported in the Stand Carbon Report, Belowground Biomass
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{L,t}$
Comments	

Data / Parameter	$\Delta C_{STORHWP,t}$
Data unit	t C yr ⁻¹
Description	Annual harvested carbon that remains in permanent storage after conversion to wood products during primary processing
Source of data	Modeled within FVS and output in the Harvest Products Report Stand Carbon Report, for the BSL and PRJ scenario respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of ΔHWP_t
Comments	

Data / Parameter	$CMILL_{h,k}$
Data unit	t C
Description	The carbon contained in harvested timber after milling in period h , for product type k
Source of data	Modeled within FVS and output in the Harvest Products Report Stand Carbon Report for the BSL and PRJ scenario respectively
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	
Comments	Calculation of ΔHWP_t

Data / Parameter	CTIMBER, h
Data unit	t C
Description	The carbon contained in timber harvested in period h
Source of data	Modeled within FVS and output in the Harvest Products Report and Stand Carbon Report for the BSL and PRJ scenario respectively.
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of ΔHWP_t
Comments	

Data / Parameter	CSTORHWP, h,t
Data unit	t C
Description	The carbon stored in harvested wood products in year t summed for all product types k and then over all harvest periods h ; t C
Source of data	Modeled within FVS and output in the Harvest Products Report Stand Carbon Report for the BSL and PRJ scenario respectively
Value applied	Calculated annually for baseline and project scenario

Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of ΔHWP_t
Comments	

Data / Parameter	fRND,k
Data unit	dimensionless
Description	The fraction of growing stock volume removed as roundwood for product type <i>k</i>
Source of data	Modeled within FVS and output in the Harvest Products Report and Stand Carbon Report for the BSL and PRJ scenario respectively. FVS-FFE uses values from the '1605b' documentation (Smith, et al (2006))
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of ΔHWP_t
Comments	

Data / Parameter	rRND,k
Data unit	dimensionless
Description	The ratio of industrial roundwood to growing stock volume removed as roundwood for product type <i>k</i>
Source of data	Modeled within FVS and output in the Harvest Products Report and Stand Carbon Report for the BSL and PRJ scenario respectively. FVS-FFE uses values from the '1605b' documentation (Smith, et al (2006))

Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of ΔHWP_t
Comments	

Data / Parameter	$\Delta C_{EMITFOSSIL,t}$
Data unit	t C yr ⁻¹
Description	The amount of carbon emitted from the burning of fossil fuels by equipment during harvesting and transport of wood products
Source of data	Modeled within the Darkwoods Carbon Model spreadsheet based on annual harvest volumes from the FPS harvest schedule
Value applied	modeled by FVS-FFE, for the BSL and PRJ scenario annual harvests respectively
Justification of choice of data or description of measurement methods and procedures applied	Calculated annually for baseline and project scenario
Purpose of data	Required for calculation of baseline and project emissions
Comments	Calculation of ΔHWP_t

Data / Parameter	$\Delta C_{EMITHARVEST,t}$
Data unit	t C yr ⁻¹
Description	The amount of carbon emitted from the burning of fossil fuels by equipment during harvesting of wood products
Source of data	Modeled within the Darkwoods Carbon Model spreadsheet based on annual harvest volumes from the FPS harvest schedule

	modeled by FVS-FFE, for the BSL and PRJ scenario annual harvests respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{EMITFOSSIL,t}$
Comments	

Data / Parameter	$\Delta C_{EMITMANUFACTURE,t}$
Data unit	t C yr ⁻¹
Description	The amount of carbon emitted from the burning of fossil fuels by equipment during manufacture of wood products
Source of data	Modeled within the Darkwoods Carbon Model spreadsheet based on annual harvest volumes from the FPS harvest schedule modeled by FVS-FFE, for the BSL and PRJ scenario annual harvests respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	
Comments	Calculation of $\Delta C_{EMITFOSSIL,t}$

Data / Parameter	$\Delta C_{EMITTRANSPORT,t}$
Data unit	t C yr ⁻¹

Description	The amount of carbon emitted from the burning of fossil fuels by equipment during transport of wood products
Source of data	Modeled within the Darkwoods Carbon Model spreadsheet based on annual harvest volumes from the FPS harvest schedule modeled by FVS-FFE, for the BSL and PRJ scenario annual harvests respectively
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of $\Delta C_{EMITFOSSIL,t}$
Comments	

Data / Parameter	LE_y
Data unit	t CO _{2e} yr ⁻¹
Description	The project market leakage in year, y
Source of data	Calculated within the Darkwoods Carbon Model using Equation 56b
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of annual project market leakage under Option 1
Comments	

Data / Parameter	MLF_y
Data unit	%
Description	The market leakage factor determined for year 'y'

Source of data	Originally Determined based upon the approach defined in Section 3.3 of PD. Deviation was applied in MR 2017 – 2019. Calculated within the Darkwoods Carbon Database
Value applied	20%
Justification of choice of data or description of measurement methods and procedures applied	Value determined using the latest version of the VCS Market Leakage Tool as defined in Agriculture, Forestry and Other Land Use (AFOLU) Requirements v3.6 and specified in the VM0012 Methodology
Purpose of data	Calculation of leakage under Option 1
Comments	

Data / Parameter	ER _y ,GROSS
Data unit	t CO ₂ e yr ⁻¹
Description	The gross difference in the overall annual carbon change between the baseline and project scenarios in year, y
Source of data	Calculated within the Darkwoods Carbon Model. Relates to equation 57
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of LE _y
Comments	

Data / Parameter	ER _y ,
Data unit	t CO ₂ e yr ⁻¹
Description	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)

Source of data	Calculated within the Darkwoods Carbon Model using Equation 58
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	
Comments	Calculation of VCU_y

Data / Parameter	VCU_y
Data unit	t CO ₂ e yr ⁻¹
Description	Amount of Verified Carbon Units the project estimates are available for issuance and sale in year 'y'
Source of data	Calculated within the Darkwoods Carbon Model using Equation 59
Value applied	Calculated annually for baseline and project scenario
Justification of choice of data or description of measurement methods and procedures applied	Required for calculation of baseline and project emissions
Purpose of data	Calculation of claimed VCU's
Comments	

Data / Parameter	E_M
Data unit	%
Description	An estimate of model error based on the relative AU 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). Calculated using FVS-FFE and the Darkwoods Carbon Database
Value applied	See Table 14
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 & project emissions
Comments	

Data / Parameter	E_i
Data unit	%
Description	An estimate of Inventory sampling error calculated as the 90% confidence limit of the AU 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). Calculated using FVS-FFE and the Darkwoods Carbon Database
Value applied	See Table 14
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 & project emissions
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). Calculated using FVS-FFE and the Darkwoods Carbon Database
Value applied	See Table 14
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 & project emissions
Comments	

Data / Parameter	ER _y ,ERR,
Data unit	%
Description	The uncertainty factor calculated for year 'y' (See Section 4.4.3)
Source of data	Model output and field data (see Equation 60f). Calculated using FVS-FFE and the Darkwoods Carbon Database
Value applied	See Table 14
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	
Comments	Calculation of baseline & project emissions

Data / Parameter	BR _y ,
Data unit	tCO ₂ e yr ⁻¹
Description	Estimated VCU-equivalent tCO ₂ e issued to the VCS Buffer Pool in year, y
Source of data	Calculated using the latest version of the VCS AFOLU Non-Permanence Risk Tool and in the Darkwoods Carbon Model

Value applied	10%
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 VCU _y
Comments	

3.1.2 Data and Parameters Monitored (VCS, 3.16)

Data / Parameter	APRJ,i
Data unit	Ha
Description	Area of forest land in polygon, i
Source of data	GIS database for polygon i.
Description of measurement methods and procedures to be applied	Determined as part of the inventory work (see Darkwoods Inventory Update Report Darkwoods_VRIEM_Ecora2012.pdf). Updated annually based on ex-post field and remote sensing data
Frequency of monitoring/recording	Annual
Value monitored	Various GIS stand polygon areas in hectares
Monitoring equipment	Visual, satellite, aerial photos
QA/QC procedures to be applied	GIS analysis is undertaken by experienced analysts utilizing standard and typical industry best practice, ArcGIS and QGIS software, and local expertise and the latest NCC Standard Operating Procedures (SOP)
Purpose of the data	Required for calculation of project emissions
Calculation method	Area of polygons calculated using GIS software
Comments	

Data / Parameter	AP,i,t
Data unit	Ha
Description	Area of permanent sample plot in polygon, i
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Standard fixed radius plot layout design using field measuring tape from plot center. Methods outlined in the latest version of the 'NCC Carbon PSP Plot Re-measurement SOP' were followed for the re-measured plots and 'NCC Carbon PSP Plot Installation SOP' for newly installed plots
Frequency of monitoring/recording	Plot measurements are repeated on 5-year intervals
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	GPS, measuring tape
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedure document. followed, including check cruising processes Specifically, this includes: 1) crew training to carefully follow the SOP document, 2) the establishment of blind check plots on 10% of the plots w/o access to original plot data, 3) the use of standardized equipment, and 4) keeping detailed data records on field sheets or data loggers
Purpose of the data	Required for determination of Uncertainty Factor
Calculation method	Measuring tape. Area = $\pi \cdot r^2$
Comments	

Data / Parameter	DBHt
Data unit	Cm
Description	Diameter at breast height measured for each tree in the sample plots at time, t
Source of data	Field measure

Description of measurement methods and procedures to be applied	Field measurements in permanent sample plots. Measurement with DBH tape for trees > 5 cm DBH
Frequency of monitoring/recording	Individual plot tree re-measurements are repeated on 5-year intervals
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	DBH tape, data logger
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP). Specifically, this includes: 1) crew training to carefully follow the SOP document, 2) the establishment of blind check plots on 10% of the plots w/o access to original plot data, 3) the use of standardized equipment, and 4) keeping detailed data records on field sheets or data loggers
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Measured by hand
Comments	

Data / Parameter	Height _t
Data unit	M
Description	Tree height data is derived from two sources: (1) LiDAR-based individual tree segmentation, and (2) field measurements from permanent sample plots. These two data sources are treated separately for this parameter table. (1) Tree height for each tree at time t, used in the estimation of aboveground biomass and carbon stocks. (2) Tree height was measured for each tree in the sample plots at time, t.
Source of data	(1) LiDAR-derived forest inventory generated from the 2021 LiDAR dataset. (2) Field Measurement.

Description of measurement methods and procedures to be applied	(1) Tree height is estimated using LiDAR-derived individual tree segmentation outputs. LiDAR data is processed to identify individual trees and derive corresponding height metrics across the Project Area. These derived tree heights are compiled into a spatially explicit individual tree list used as inputs for the Forest Vegetation Simulator (FVS). This approach replaces direct field-based height measurements from permanent sample plots, as permitted under the approved methodology deviation for this monitoring period. The deviation was applied to better capture tree height variability across stands and to provide a more accurate and conservative representation of forest structure. (2) Field measurements in permanent sample plots using a vertex or hypsometer.
Frequency of monitoring/recording	(1) Once per monitoring period (upon acquisition of new LiDAR data or significant forest structural change). (2) Individual plot tree re-measurements are repeated on 5-year intervals.
Value monitored	(1) LiDAR-derived individual tree list containing species, height, and other attributes used for FVS model initialization and carbon stock estimation. (2) Tree height within plots. See Darkwoods Plot Data excel sheet
Monitoring equipment	(1) Airborne LiDAR system (fixed-wing or UAV), processed using tree segmentation algorithms implemented in a LiDAR processing workflow. (2) Hypsometer, a transit, a clinometer, a relascope, a laser or other instrument designed for the measuring height.
QA/QC procedures to be applied	(1) LiDAR-derived height estimates were validated against field plot measurements collected within the project area to ensure accuracy and conservativeness. Validation results demonstrate strong correlation with field data. Documentation of the LiDAR processing workflow and validation results is provided to the VVB. (2) NCC Carbon Plot Standard Operating Procedures (SOP). Specifically, this includes: 1) crew training to carefully follow the SOP document, 2) the establishment of blind check plots on 10% of the plots w/o access to original plot data, 3) the use of standardized equipment, and 4)

	keeping detailed data records on field sheets or data loggers
Purpose of the data	(1) Required for the estimation of aboveground biomass and carbon stocks. (2) Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	(1) Tree heights are computed from LiDAR-derived canopy height models (CHMs) and/or point-cloud segmentation outputs. (2) Measured using Vertex.
Comments	The tree height parameter is measured in two different ways in this project. It is measured using LiDAR for biomass estimation across the project area, and within plots to determine the Uncertainty Factor.

Data / Parameter	Lt
Data unit	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 (default 100m)
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied	Field measurements
Frequency of monitoring/recording	Every 5 years
Value monitored	100m
Monitoring equipment	Tape
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions

Calculation method	Measuring tape
Comments	

Data / Parameter	dn,t
Data unit	cm
Description	Calculation of lying dead wood: Diameter of each piece n of dead wood along the transects in the sample plot at time, t
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied	Lying dead wood must be sampled using the line intersect method (Harmon & Sexton, 1996). Two 50-m lines are established bisecting each plot and the diameters of the lying wood (> 10 cm diameter) intersecting the lines are measured Minimum measurement diameter must not be less than 10cm
Frequency of monitoring/recording	Every 5 years
Value monitored	See “Darkwoods Plot Data Final_2021_MASTER.xlsx”
Monitoring equipment	Caliper, diameter tape
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Measuring tape
Comments	

Data / Parameter	DLDWc,i,t
Data unit	t d.m. m ⁻³
Description	Basic wood density of dead wood in the density class, c along the transect in polygon, i, at time, t
Source of data	Two 50-m lines are established bisecting each plot and wood pieces > 10 cm diameter intersecting transect are measured

Description of measurement methods and procedures to be applied	Decay class is determined from visual and tactile inspection (See latest NCC Carbon Plot SOP)
Frequency of monitoring/recording	Every 5 years
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	Visual and tactile inspection
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Values for different decay classes derived from literature values from Heath and Chojnacky (1995) – softwood species
Comments	In prior monitoring periods these have been compared to values reported for more local species in Harmon et al. (2011) and found to be consistent. Further a sensitivity analysis shows that the decay class wood densities can shift +/- 50% and still have no effect on the uncertainty factor

Data / Parameter	N,t
Data unit	unitless
Description	Total number of wood pieces intersecting the transect in the sample plot, in time t
Source of data	Field Measurement
Description of measurement methods and procedures to be applied	Lying dead wood is sampled using the line intersect method (Harmon & Sexton, 1996). Two 50-m lines are established bisecting each plot and the total number of wood pieces intersecting transect are counted
Frequency of monitoring/recording	Every 5 years
Value monitored	See Darkwoods Plot Data excel sheet

Monitoring equipment	Visual observation
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Field count
Comments	

Data / Parameter	BAG i,t
Data unit	t d.m. ha ⁻¹
Description	Aboveground live tree biomass in polygon, i, year, t
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied	Calculated from Height _t , DBH _t , and A _{P,i,t}
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	See equipment for Height and DBH
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Calculated by inputting plot tree data into FVS-FFE. Area-based estimates of biomass are then be derived by summing all trees in plot and dividing by plot area
Comments	Data used to validate ex-ante values from inventory + model output

Data / Parameter	BBG _{i,t}
Data unit	t d.m. ha ⁻¹
Description	Belowground live tree biomass in polygon, i, year, t, in the project case
Source of data	Derived from above ground biomass calculations within permanent sample plots
Description of measurement methods and procedures to be applied	Calculated from BAG _{i,t} and R _i
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	N/A
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	BBG _{i,t} = BAG _{i,t} * R _i
Comments	Estimated

Data / Parameter	BTOTAL _{i,t}
Data unit	t d.m. ha ⁻¹
Description	Sum of BAG _{i,t} and BBG _{i,t}
Source of data	Derived from above ground biomass calculations within permanent sample plots
Description of measurement methods and procedures to be applied	Sum of BAG _{i,t} and BBG _{i,t}

Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Sum of BAG _{i,t} and BBG _{i,t}
Comments	

Data / Parameter	DOMLDW _{i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Average mass of dead organic matter contained in lying dead wood in polygon, i, year, t
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied	Calculated from using line intersect method (See – ‘NCC Carbon PSP Plot Re-measurement SOP 2016 v1.0.pdf’) and Pearson et al (2007)
Frequency of monitoring/recording	Every 5 years
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	Tape and visual inspection
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP).
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Calculated using the following field- measured parameters L _{i,t} , dn _{i,t} , D _{LDWC,i,t} , and N _{i,t} as follows:

	$DOMLDW = \sum MLDW_{,c}$ where, $M_{LDW,c}$ = the mass of LDW in density class, c (t ha ⁻¹) $MLDW_{,c} = VLDW_{,c} *$ $DLDW_{,c}$ where, $V_{LDW,c}$ = the volume per unit area calculated for each density class, c, $D_{LDW,c}$ = the density of LDW in density class, c (t d.m. m ⁻³)
Comments	

Data / Parameter	DOMSNAG,i,t
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Average 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 to be applied	Compiled in FVS from field plot measurements
Frequency of monitoring/recording	Every 5 years
Value monitored	See Darkwoods Plot Data excel sheet
Monitoring equipment	na
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for determination of Uncertainty Factor and ultimately for calculation of project emissions
Calculation method	Compiled in FVS-FFE
Comments	

Data / Parameter	fPRJ,NATURAL,i,t
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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
Source of data	1. Permanent sample plots; 2. FVS-FFE modeling and forest inventory updates (i.e. fires by severity, etc.)
Description of measurement methods and procedures to be applied	1. Height and dbh of dead trees in permanent sample plots will be recorded and compiled in FVS-FFE 2. Field GPS measured or remote sensing to update forest inventory for fires and other disturbances, which are then modeled for mortality using FVS-FFE
Frequency of monitoring/recording	1. Every 5 years in the case of plots 2. Annually in the case of inventory updates for disturbances
Value monitored	See Darkwoods Plot Data excel sheet for plots and Darkwoods Carbon Databases for mortality
Monitoring equipment	Field measurement and remote sensing/GIS analysis
QA/QC procedures to be applied	Latest NCC Carbon Plot Standard Operating Procedures (SOP)
Purpose of the data	Required for project calculations
Calculation method	Compiled in FVS-FFE
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
Source of data	Either NCC harvesting records or estimated from FVS-FFE modeled inventory data for the harvest area(s)

Description of measurement methods and procedures to be applied	Harvest boundaries are mapped using field GPS or remote sensing methods and then overlaid with inventory data to determine how much biomass is removed from polygon i. New polygon boundaries may be formed when harvest boundaries don't match underlying
Frequency of monitoring/recording	inventory polygons. NCC delivered harvest volumes may be substituted
Value monitored	Annually
Monitoring equipment	Project harvesting deliveries volumes
QA/QC procedures to be applied	GPS
Purpose of the data	Data will be verified by ground-truthing and comparison with remote sensing information
Calculation method	Required for calculation of project emissions
Comments	Harvest boundaries are mapped using field GPS methods or remote sensing and then overlaid with inventory data to determine how much biomass is removed from polygon i. New polygon boundaries may be formed when harvest boundaries don't match underlying inventory polygons

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
Description of measurement methods and procedures to be applied	Remote sensing or field GPS measurements
Frequency of monitoring/recording	Annually
Value monitored	No project damage was recorded in this period

Monitoring equipment	Remote sensing or field GPS measurement
QA/QC procedures to be applied	Data will be verified by ground-truthing or remote sensing information
Purpose of the data	Required for calculation of project emissions
Calculation method	Any new permanent road or landing polygons are determined by field GPS or remote sensing, and then are overlaid on inventory polygons and biomass that was removed from those areas is quantified
Comments	

Data / Parameter	fPRJ,BLOWDOWN,i,t
Data unit	unitless; $0 \leq \text{fPRJ,BLOWDOWN,i,t} \leq 1$
Description	The annual proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t
Source of data	Remote sensing or field GPS measurements
Description of measurement methods and procedures to be applied	1. Measured in plots 2. Field GPS or remote sensing for areas > 4 ha which are then updated in the inventory polygons
Frequency of monitoring/recording	At plot remeasurement, or annually via remote sensing
Value monitored	No areas of blowdown >4 ha occurred in this period
Monitoring equipment	Aerial photos or plot measurement equipment
QA/QC procedures to be applied	Data will be verified by ground-truthing or remote sensing information
Purpose of the data	Required for project calculations
Calculation method	Areal estimate of removals is multiplied by average carbon density within a polygon or plot
Comments	

Data / Parameter	fPRJ,SNAGFALLDOWN,i,t
Data unit	unitless; $0 \leq f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$
Description	The annual proportion of snag biomass in polygon, i, year, t, that falls over and thus is transferred to the LDW pool
Source of data	1. Permanent sample plots 2. FVS-FFE modeling and forest inventory updates
Description of measurement methods and procedures to be applied	Modeled by FVS, Also measured during plot remeasurements
Frequency of monitoring/recording	Annually; every 5 years for plot remeasurements
Value monitored	Variable
Monitoring equipment	FVS software; standard plot remeasurement equipment
QA/QC procedures to be applied	For plot remeasurements, see King County Standard Operating Procedures (SOP)
Purpose of the data	Required for project calculations
Calculation method	Modeled by FVS based on changes in plot data over time
Comments	

Data / Parameter	fPRJ,lwDECAY,i,t
Data unit	unitless; $0 < f_{PRJ,lwDECAY,i,t} < 1$
Description	The annual proportional loss of lying dead biomass due to decay, in polygon i, year, t
Source of data	1. Permanent sample plots 2. FVS-FFE modeling and forest inventory updates (i.e. fires by severity, etc.)

Description of measurement methods and procedures to be applied	1. For plot data, LDW decay is estimated naturally by changes in CWD remeasurements across multiple remeasurement periods 2. Otherwise modeled by FVS-FFE for inventory updates
Frequency of monitoring/recording	Every 5 years for plot remeasurements, annually for modeled inventory updates
Value monitored	Variable
Monitoring equipment	Standard plot remeasurement equipment, GIS and FVS-FFE
QA/QC procedures to be applied	Latest NCC Standard Operating Procedures for plots and data
Purpose of the data	Required for project calculations
Calculation method	Calculated using the following field-measured parameters $L_{i,t}$, $d_{i,t}$, $DLDW_{c,i,t}$, and $N_{i,t}$
Comments	

Data / Parameter	$f_{PRJ,SWDECAY,i,t}$
Data unit	unitless; $0 < f_{PRJ,SWDECAY,i,t} < 1$
Description	The annual proportional loss of snag biomass due to decay, in polygon, i, year, t.
Source of data	1. Permanent sample plots 2. FVS-FFE modeling and forest inventory updates
Description of measurement methods and procedures to be applied	1. For plot data, SW decay is estimated naturally by changes in dead tree remeasurements across multiple measurement periods 2. Otherwise modeled by FVS-FFE for inventory updates
Frequency of monitoring/recording	Every 5 years for plot remeasurements; annually for modeled inventory updates
Value monitored	Variable.
Monitoring equipment	Standard plot remeasurement equipment, GIS and FVS-FFE.

QA/QC procedures to be applied	Latest NCC Standard Operating Procedures for plots and data.
Purpose of the data	Required for project calculations
Calculation method	Calculated by FVS-FFE from plot data
Comments	

3.1.3 Monitoring Plan (VCS, 3.16, 3.20)

Information regarding the organizational structure, responsibilities, and competencies of the personnel that carried out the monitoring activities for the project are provided in Section 2.4. NCC is a national conservation organization with a defined set of roles and responsibilities, based generally on a regional leadership model to handle all aspects of their business, with the Darkwoods property sitting within the BC Region. The NCC BC Region is responsible for the management of the Darkwoods property overall. Operational property oversight and management is handled by the Darkwoods Site Manager with support from various regional and national personnel. NCC National Office heads all carbon initiatives and carbon business in conjunction with the BC Region. Carbon project design, reporting, and related advisory services and expertise are provided by Ostrom Climate to NCC. Operationally, the monitoring for all elements of the carbon project are undertaken by BC Regional staff, primarily headed by the Darkwoods Site Manager. Ostrom Climate handles all carbon project data analysis and modeling (in conjunction with NCC GIS staff), complies project reporting, and provides technical oversight and advice to the project on an ongoing basis.

The Darkwoods project monitoring plan contains three primary activities:

1. Annual inventory change monitoring

NCC has undertaken a non-systematic spatial monitoring on the entire property annually over the monitoring period, and the GIS inventory is updated annually. This was undertaken via a combination of aerial helicopter reconnaissance, field observations, field surveys of identified project activities, and field surveys of any identified disturbance events (i.e. fires, etc.). In addition, NCC has updated inventory databases with information from biodiversity and other non-carbon monitoring programs installed since 2008.

In 2021 NCC undertook a new LiDAR-derived forest inventory which has further brought the stand level inventory metrics up to current. Further details on the inventory data collection and analysis process is available to auditors upon request.

- a. **Natural disturbance events (i.e. fires, high mortality pest and disease areas, blow-down areas, slides, etc.).**

NCC has collected monitoring data on the spatial extent of annual forest fires during the monitoring period. There were three fires on the Darkwoods Property in 2022, which covered ~702 ha of land in the Property Area. In 2023, there were four minor fires, covering ~2 ha of land in the Property Area. The burned area was mapped for fire severity using established remote sensing techniques using best available pre- and post-fire satellite multispectral imagery acquired by the MultiSpectral Instrument (MSI) aboard the Sentinel-2 satellite or the Operational Land Imager (OLI) sensor aboard the Landsat-8 and 9 satellites by the BC Ministry of Forests (MOF). Figure 4 shows the burn severity for the fires on the Darkwoods property during this monitoring period. The severity tracking reveals that the fires were of mixed severity and is classified as shown in Table 9. The project has utilized this burn severity data to improve the accuracy of carbon emissions modelling.

As mentioned in Section 2.2.7, the forest within the fire-affected area for the 2021 event (for which a loss report was submitted) continued to respond to the effects of the fire into vintage 2022. This was reported by BC Ministry of Forests (MOF) in 2022, when they updated burn severity ratings that were initially described in 2021 (and included in the carbon calculations from the previous monitoring period) using remote sensing images collected in July 2022. The history of forest fires on the property during the project lifetime is shown in Table 10.

Darkwoods

Fire 2022 / 2023

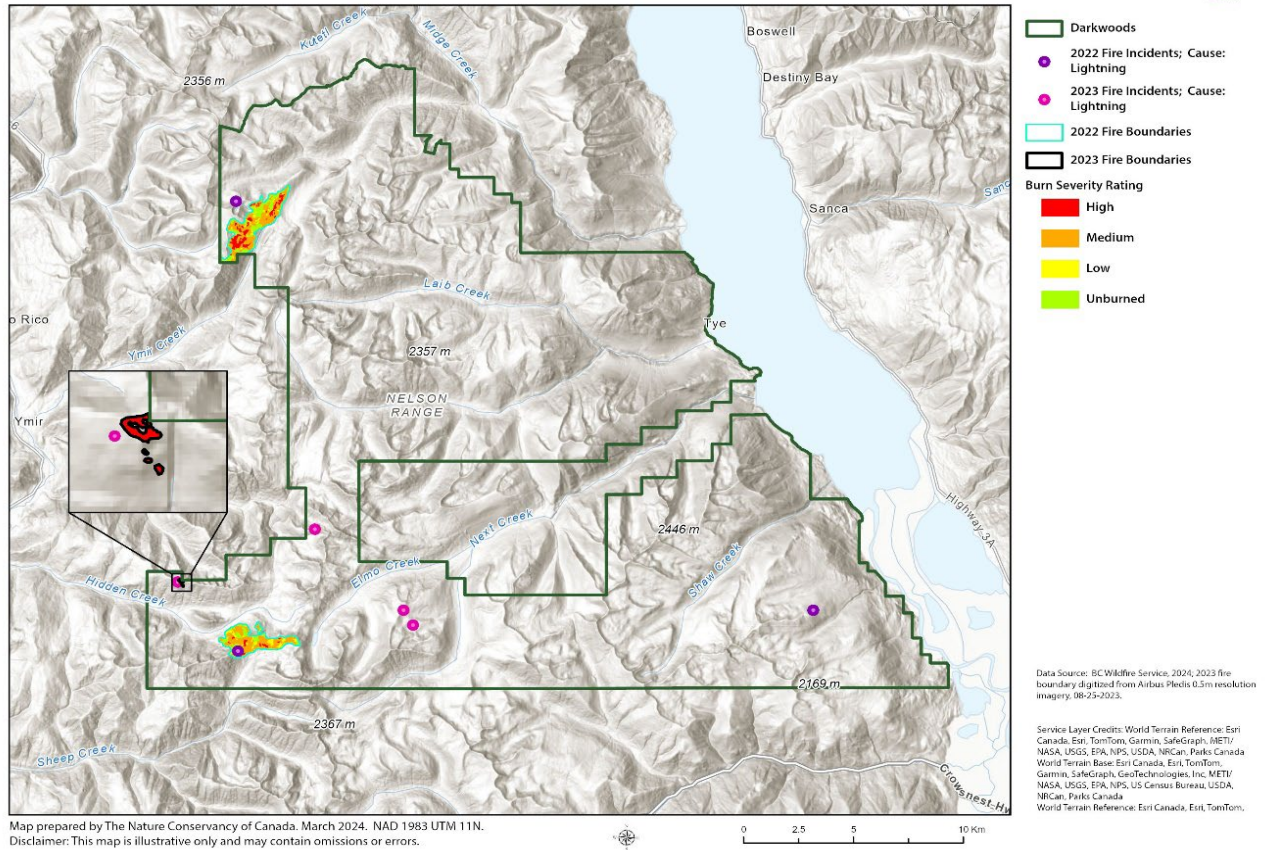


Figure 4. Fires that occurred in the Property Area and their severity rating during this monitoring period

Table 9: Fire Events 2022-2023

Year	Burn Severity Class ³⁷	GIS Hectares	% of Fire Area	Modeling Assumption
2022	Unburned	184.3	26.2	Trees within fire area that have not been burned
	Low	64.68	9.2	No impact on biomass stocks ³⁸

³⁷ Burn Severity Class descriptions can be found in the Post-wildfire Natural Hazards Risk Analysis in British Columbia: <https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh69.pdf>

³⁸ Generally, this assumption is that these stand areas will remain similarly stocked and did not, on average, lose significant amounts of tree biomass volume; and any loss will likely be recovered rapidly due to nutrient flushing, reduced competition, etc.

	Medium	368.1	52.4	Moderate fire parameters
	High	85.27	12.1	Severe fire parameters ³⁹
	Subtotal	702.36	100	-
2023	High	2.09	100	Severe fire parameters ²⁷
	Subtotal	2.09	100	-
Total	-	704.45		

Table 10: Darkwoods Monitored Fire events since 2013

Project Year	# of Fire Occurrences	Monitored Fire Occurrence (ha)
2013	0	0
2014	4	81
2015	1	102
2016	0	0
2017	0	0
2018	2	2,447
2019	0	0
2020	0	0
2021	1	4,485 ⁴⁰
2022	3	702
2023	4	2

No other natural disturbance events occurred in the Project Area during the monitoring period.

³⁹ CCB PD Section 4.1

⁴⁰ 4,485 ha was the correct monitored fire size in 2021 when the previous monitoring report was verified. The fire severity dataset has since been updated for 2021, which now shows a different value for fire size.

2. Planned project activities (i.e. harvests, road construction, reforestation, etc.)

Table 11: Darkwoods Project Harvesting Activities 2022-2023

Project Year	Year	Ex-Post Projected Volume (m ³)	Ex-Post Delivered Volume (m ³)	Ex-Post Actual Area (ha)
15	2022	2,894.1	2,894.1	34.89
16	2023	8,656.3	8,656.3	30.50
	Total	11,550.4	11,550.4	65.48

3. Unplanned man-made disturbances (i.e. non-de minimis illegal or unplanned harvests, etc.):

No unplanned or illegal harvest or other activities were observed on the property during the monitoring period; thus, no inventory updates or adjustments have been necessary. NCC has completed an access management plan, installed access controls on the property (i.e. gates), installed motion sensor devices and implemented a mandatory permit system to monitor access on the property.

4. Other Monitoring Requirements of the Project

NCC will also document other monitoring requirements of the PD, including:

- Activity shifting leakage (annually)

NCC has not undertaken any commercial timber harvesting on any other owned or managed property during this monitoring period. However, it is important to note that while NCC has harvested and sold a small amount of timber for the purpose of improving the forest health and conservation value of a property, it is in alignment with the detailed property management plan and has not been harvested for commercial purposes.

In addition to a financial summary that will be provided to the auditor, a representation letter will also be provided to the auditor as confirmation that NCC did not conduct commercial timber harvesting outside the Darkwoods property during the 2022-2023 monitoring period.

Table 12: NCC Logging Activity on Other Properties (activity shifting risk) 2022-2023

Property	Project Year	Logging volume (m ³)	Activity shifting evidence/comment
All NCC properties outside Darkwoods	2022	0.0	n/a – no commercial harvest

All NCC properties outside Darkwoods	2023	0.0	n/a – no commercial harvest
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- Annual market leakage calculations (annually)

Annual calculations of market leakage are shown in Section 3.2.3

- Field plot monitoring

Field plot monitoring is described in detail below.

- Sampling: Carbon Plots and Re-measurement:

No field plots have been remeasured or established, nor has LiDAR data been updated, since 2021. The following information outlines the process undertaken at that time, during the 2020-2021 monitoring period as that inventory still applies for this 2022-2023 monitoring period.

The project has installed a total of 75 active permanent sample plots for carbon, however, as of 2021, one plot has burned in a fire, resulting in a total of 74 plots. All eligible plots have undergone a remeasurement period. 31 plots were installed in 2021, including the replacement of certain high cost, remote helicopter plots, which were removed and discarded in the 2020-2021 monitoring period and replaced by randomly selected new replacement plots in similar AU and stand conditions, along with re-installing a few plots lost to fire, and to improve AU targets. The remaining 43 plots were remeasured in 2021. The inventory error term sits at 9.7% and the project error term sits at -8.6% suggesting that the project has the appropriate number of plots to approximately achieve error targets (net change in carbon stocks within 10 percent of the true value of the mean at the 90-percent confidence), for the time being. All plot locations, types, tree data and CWD data are stored in an excel spreadsheet which was provided to verifiers for review during the 2020-2021 verification.

Table 13: Summary of actual plots and expected plots by analysis unit

Analysis Unit (BA Class)	Area (ha)	Actual plots	Expected plots ⁴¹
5	7,849.9	1	11
15	9,954.32	6	15

⁴¹ Expected number of plots is calculated by weighting the total number of installed plots based upon the total productive forest area in analysis unit relative to the total productive forest area.

25	9,783.10	23	14
35	8,936.5	20	13
45	6,223.65	13	9
55	3,963.5	10	6
65	3,904.1	1	6
Total Project Area	50,615.04	74	74⁴²

Plot Data Analysis Summary

Following VM0012, the project models carbon from forest inventory data on a stand level, and then uses this carbon plot data to monitor both the development of aboveground carbon stocks over time and to monitor the accuracy of modeled carbon stocks and inventory by analysis unit; which then is then used to adjust emission reductions using the uncertainty factor statistical analysis and deductions. The project calculates actual carbon content on each plot on a tC/hectare basis using the tree and CWD data collected on each plot. In this monitoring period, this data is input as stand data into the FVS-FFE model which outputs aboveground standing live and dead carbon for each plot. The aboveground standing carbon stock pools from FVS are used in these calculations.

The downed and dead (i.e. CWD) outputs from FVS are modeled results based on stand inventory inputs and therefore these data are replaced with manual CWD calculations from the plot transect results. CWD transect data is calculated separately in the project Excel database following equations⁴³ to convert transect measured data into tC/hectare. FVS does not have an imbedded method to insert transect based data for calculating actual down and dead carbon volumes. Therefore, the transect data is calculated externally and then manually added back to replace the down and dead carbon estimated from the tree data in FVS-FFE. The resulting tree data and CWD data outputs a total actual carbon content in the plot on a tC/hectare basis.

This total aboveground plot ecosystem carbon data by polygon summarized to each AU is then used to compare to the actual carbon stocks from plots on an analysis units basis to the modeled carbon stocks across the Project Area on each AU. These data are compared in the uncertainty factor calculation below.

⁴² Originally 75 plots were installed, however a fire in 2021 led to one plot being burned.

⁴³ Pearson, Timothy R.H.; Brown, Sandra L.; Birdsey, Richard A. 2007. Measurement guidelines for the sequestration of forest carbon. Gen. Tech. Rep. NRS-18. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 42 p.

Quality Assurance/Quality Control Measures (QA/QC)

- The QA/QC standards described in the PD were adhered to during this monitoring period: The below is pertaining to the QA/QC of field measurements in the monitoring period of 2020-2021, the data of which applies to this monitoring period.
- QA/QC for Field Measurements conducted during the 2020-21 monitoring period, and are applicable to this monitoring period:
- NCC undertook blind check cruises for ~10% of the plots in the season of install or re-measurement. Check plots were undertaken by experienced field staff or Darkwoods staff on a blind basis. Eight check plots were installed relative to the latest plot datasets. DBH, Height, and Tree Count measurements met the accuracy threshold of (+/-)10% at 90% CI, as required by the PD. The raw QA/QC plot data and analysis were made available to the VVB during the 2020-2021 verification available in an Excel file.
- QA/QC for Data Entry for 2020-2021 monitoring period: NCC standard procedures and ongoing QA/QC programs for data were followed to ensure proper entry of data from paper to electronic format (see latest version of the Darkwoods Data Standards). The primary quality mechanism in the project is electronic data recorders with field-based entry followed by electronic file transmission for further data analysis. No errors were noted during analysis for this verification period.
- QA/QC for Data Archiving for 2020-2021 monitoring period:

NCC has stored the electronic field data files and summary excel files on NCC servers and in Dropbox project folders, and age core samples are retained at the Darkwoods field office (see latest version of the Darkwoods Data Standards).

3.1.4 Dissemination of Monitoring Plan and Results (VCS, 3.18; CCB, CL4.2)

Information related to Darkwoods is disseminated via NCC's Darkwoods website⁴⁴

NCC posts materials and results that are of interest to stakeholders for the Property Area on a periodic basis, along with periodic related posts on social media. See Sections 2.3.2 and 2.3.3 for additional information on communication of materials.

⁴⁴ <https://www.natureconservancy.ca/en/what-we-do/nature-and-climate/dw-carbon.html>

3.2 Quantification of GHG Emission Reductions and Removals

For this monitoring period, baseline emissions were calculated using the same process outlined in VM0012 and the PD. As noted, the project used the same IE Variant as in the prior verification due to issues in the BC Variant model functionality. To simulate stand development and conditions for this monitoring period, the project has started with the same base 2021 LiDAR-derived Enhanced Forest Inventory. The same primary landbase stratifications were made to the forest inventory data, as described below, with the exception of the Analysis Units, which were re-defined during the 2020-2021 monitoring period, as described below. As per the new deviation added in this monitoring period, AU111 is no longer used in quantification of the GHG ERR's.

Stratification of Land Area

As per the PD, GIS software was used to stratify the forest inventory across the landbase. The same shapefiles and data procedures were used as the prior monitoring report. Summarized, this GIS forest inventory stratification/filtering includes:

- Identify the forested vs non-forested area based on IPCC criteria. Non-forested polygons have not been carbon modeled for the purpose of this analysis.
- Identify road and stream buffers: road and stream buffers are applied using the same method as the PD, with a 5m buffer each side road right-of-way applied to road lines, and 3m each side of stream channel zones applied following standard regional practice. A minor modification was made in the 2020-21 monitoring period to remove these road and stream areas from polygon gross hectares to create net productive hectares for each polygon, rather than 'cutting in' the buffer polygons. This accounts for the road and stream areas correctly but significantly reduces the number of polygons that were created when roads and streams were cut out as new polygons in prior work. Both road and stream areas (i.e. polygon gross hectares minus net hectares) are treated as non-forest in both scenarios.
- Identify the operable landbase (net operable area): the operable landbase linework was developed in the PDD following provincial common practice, as described in the PD. Operable and inoperable areas are included in carbon modeling, but inoperable areas are excluded from baseline and project activities. No changes have been made to this line work in this monitoring period.
- Identify economically viable stands estimated to be uneconomical are filtered using the same criteria described in the PD. Uneconomical stands include all hardwood leading, all hemlock, cedar or subalpine fir leading stands >159 years of age and stands with site index < 8. Uneconomical stands are modeled for carbon, but excluded for baseline/scenario activities. There has been no change to this procedure.

These same parameters have been applied to both scenarios in this monitoring period.

The output of this stratification is the Timber Harvesting Landbase (THLB) for the project, which is the set of polygons on the landbase that are productive forest, operable, and economical to harvest and which are subject to harvesting activities in either the baseline or project scenario. The THLB is therefore the same for the baseline and project scenarios prior to the application of project and baseline harvesting activities and other biomass removals. Areas outside the THLB contain carbon stocks that are modeled and contribute to total ecosystem carbon in both scenarios, but these areas typically have no material differences between the project and baseline scenario, and hence will net out between the scenarios and not contribute to net emission reductions. The project and baseline scenario carbon stock change calculations are then calculated using the same inventory and THLB area. The baseline includes modeled outcomes from baseline annual harvesting tracked spatially and modeled to the current inventory and adjusted against natural disturbances in modeling. The project scenario activities are up to date in the new inventory, so no further modeling of project activities is necessary in this monitoring period.

There have been no changes to this GIS inventory/landbase stratification process to determine the project THLB in this monitoring period.

Stratification of Forested Area in Analysis Units for Carbon Analysis

Using the Project Area and the stratifications from above, the project then stratifies the land base into analysis units (AU's) for carbon analysis in both the project and baseline scenario. For the 2020-21 monitoring period, the project implemented a deviation from the AU stratification process described in Section 4.1 of the PDD. This deviation also applies to this monitoring period.

In the PD, and in verifications prior to the 2020-21 vintages, the project used a set of AU stratification criteria, including species groupings, site index, and a single age category break point. In these prior verifications, various modifications to the original AU criteria were made to refine the AU's to inventory conditions. However, the project also noted a high level of variation at the plot level, and the inventory accuracy represented in the Uncertainty Factor calculation was beginning to decline in accuracy. In retrospect it is possible that species and site index are not the ideal AU criteria for grouping similar carbon content stands.

Therefore, the project decided for the 2020-21 verification to change the AU criteria to a simpler system, which stratifies based on basal area from the new inventory. Basal area is a common forestry metric, well represented in all forest inventories at the stand level. Basal area is based on (and well correlated with) standing timber volume, and therefore is likely well correlated with stand biomass and carbon. By re-stratifying the AU's on basal area, the project can significantly improve the accuracy of the carbon modeling, as shown by the markedly improved Uncertainty Factor in the 2020-21 monitoring period and this monitoring period.

The project continues to model stand level carbon using FVS-FFE, which is then summed with stand totals across all carbon pools by analysis unit for productive forest stands.

The assignment criteria used to simulate the analysis units in the FVS model are shown in

AU	Basal Area Criteria
5	BA: >0 to <=10
15	BA: >10 to <=20
25	BA: >20 to <=30
35	BA: >30 to <=40
45	BA: >40 to <=50
55	BA: >50 to <=60
65	BA: >60

Table 14. Assignment criteria for carbon analysis units for the 2022-2023 period using FVS-FFE

Model Selection and Use

The FVS-FFE (IE Variant) and the FPS harvest scheduling model were used in this monitoring period (no change from the prior verification period models). The FVS-FFE model meets the requirements for model selection as listed in VM0012:

1. FVS-FFE has been in use and under development for >10 years
2. FVS-FFE can generate values on <10-year increments
3. FVS-FFE and the IE Variant include stand dynamics and mortality regimes that are regionally specific and tested.
4. FVS-FFE outputs both biomass and carbon for all of the required carbon pools. The IE Variant includes growth and yield and expansion factors that are regionally appropriate.
5. FVS-FFE is well documented and involved in many peer reviewed and published documents. The model is created and used by the United States Forest Service in forest management, carbon applications, and for research purposes.
6. The model has been parameterized and calibrated for the specific conditions of the project. Project Area stand inventory tree data was used in the model; additional site-specific calibrations/parameters were based on BC Biogeoclimatic codes (BEC codes), elevation, aspect, and lat/long by polygon. The main calibrations are based on extensive of USFS work from the adjacent IE Variant.
7. FVS-FFE is used and documented extensively to model both harvesting and natural disturbances for the project and baseline scenarios. FVS can model a very wide range of timber harvesting scenarios, including the partial cutting (estimate 30% retention on all blocks during monitoring period) currently in use in this project. The FFE module is specifically designed to model fire, which has been the primary natural disturbance type.

8. FVS-FFE is used and documented extensively to model both harvesting and natural disturbances for the project and baseline scenarios. FVS can model a very wide range of timber harvesting scenarios, including the clearcutting currently in use in this project. The FFE module is specifically designed to model fire, which has been the primary natural disturbance type.
9. FVS-FFE is a stand-based model that also models all carbon pools with the FFE module. Further, FVS-FFE models Harvested Wood Product pools as required by VCS. The FPS harvest scheduling model is also well documented and established and uses the FVS-FFE inputs.

As noted in VM0012, FVS itself was designed as a timber growth and yield model. However, the FFE module adds carbon pool level processes well suited for carbon modeling in this project.

The baseline and project scenarios are modeled using FVS-FFE using the same inventory, THLB, and including forest fire disturbances in both scenarios. The baseline scenario utilizes the same 2022 inventory, but is modeled with the baseline harvest activities to date being 'hard coded' into the baseline inventory, using a spatially explicit baseline harvesting schedule by project year, and adjusted to model the impacts of any natural disturbances on top of the baseline harvest scenario (i.e. for example, fire modeling will be altered by the presence of a recent baseline clearcut (low fuels), while the adjacent/nearby stands would be burned to the same extent as the project scenario).

3.2.1 Baseline Emissions (VCS, 3.15)

The quantification of baseline emissions follows the process outlined in the applied VM0012 v1.2 methodology. A comprehensive list of all equations used to calculate the annual carbon balance for the baseline scenario, including changes in ecosystem pools and harvested wood products, is provided in Appendix 2: *VM0012 Quantification Equations*

The baseline and project scenarios start from the identical 2021 LiDAR-derived EFI inventory dataset, informed by an individual tree list created by Forsite (document x provided to the VVB) stratified into the THLB polygons as described in Section 3.2.

The baseline harvesting scenario is then applied at harvest levels projected and described in the PD, which results in harvesting of mature timber stocks at a targeted rate of ~300,000 m³/yr over a period of 15-20 years from the project start (which will be followed by lower harvest rates based on available mature inventory development in the future). Although intended as a volumetric baseline scenario, the project has 'hard coded' the baseline harvest by year and polygon for all prior years in order to model and track the changes in baseline carbon stocks over time. The baseline harvest polygons have been identified by polygon and are retained as a spatially explicit harvest area going forward. The baseline harvest polygons since the project start date have been retained and inserted into the 2022 inventory data to model the baseline scenario carbon stock changes after harvest.

For the updated inventory in the previous monitoring period, the new baseline harvest volume and areas were simulated for the baseline scenario up to the year 2028 using the Forest Projection System (FPS-ATLAS) forest scheduling model to 'select harvest blocks', and then the FVS-FFE model is used to model and track the baseline inventory and carbon stock changes over time. FPS-ATLAS uses a simple harvest scheduler with a target annual volume (~300,000 m³/yr), and selecting polygons with highest volume first. As expected, FPS-ATLAS was able to achieve the target harvest volume for 2022 and 2023 from remaining baseline inventory merchantable timber stocks.

The carbon emissions and carbon pool changes associated with the baseline scenario are tracked in FVS-FFE by applying the FPS-ATLAS harvest schedule by polygon, by year, and using the same methods and modeling assumptions as for the project scenario, but using the current baseline inventory data for each year. FVS-FFE tracks stand growth, mortality, and dynamics; harvesting removals; disturbances; and regeneration, by carbon pool, by year, including harvested wood products pools for each scenario. The data outputs from FVS-FFE are compiled and summarized within the Darkwoods Excel Database and Darkwoods Forest Carbon Model excel (the latter of which also tracks emissions from fossil fuels from equipment and manufacturing).

Similar to the last verification, the project uses FVS-FFE (Fire Fuels Extension) fire modeling capabilities to model carbon pool dynamics after fire, by severity class, against the stand types present in the project and baseline inventory datasets at the time of the fire, respectively.

The project continues to track HWP pools to meet VM0012 v.1.2 requirements by using FVS_FFE Harvest Wood Report functionality. Prior period HWP pool balances and dynamics have been tracked forward from the prior period into 2022 in both scenarios.

Summarized, for this monitoring period, baseline stand-level inventory was grown from the updated 2021 LiDAR-derived EFI inventory.

Enhanced Forest Inventory, incorporating the FPS, generated baseline harvest schedule and the 2022 and 2023 fires. Forests are regrown after harvest and regenerate after fire using the natural regeneration functions in the FVS model.

Further details related to the modeling of carbon stocks with FVS-FFE, the Darkwoods Excel Database and the Darkwoods Carbon Model excel tools are provided separately. More detailed modeling and analysis procedures are provided in the DW_2022_2023_Quantification Methods document.

Calculation of annual emissions/reductions:

Annual emissions/reductions for the baseline scenario for the years 2022-2023 were calculated using the output from the FVS-FFE and FPS model simulations, and were compiled/tracked in the Darkwoods Carbon Excel Database Tool and Darkwoods Carbon Model spreadsheet. The baseline scenario was modeled using the same assumptions laid out in Section 2.4 of the PD. The baseline

scenario was based on a modeled harvest target of 300,000m³/yr each year in this monitoring period. Outputs with respect to volume harvested and annual emissions/reductions (including key components) for this monitoring period are shown in Table 15. Further details on the use of FVS-FFE by VM0012 equation can be found in the DW_2022_2023_Quantification Methods document.

Table 15: Annual emissions/reductions for the baseline scenario calculated for 2022-2023.

Year	Baseline (Emissions) Reductions (tCO _{2e})	Volume Harvested (m ³)	Baseline Storage HWP (tC)	Baseline Storage Waste Products (tC)	Baseline (Emissions) Equipment & Production (tC)
2022	53,853	300,046	34,028	2,807	(4,662)
2023	(187,020)	301,942	19,560	7,271	(4,347)

3.2.2 Project Emissions (VCS, 3.15)

The quantification of project emissions also follows the process outlined in the applied VM0012 v1.2 methodology. The specific equations used to calculate the annual carbon balance for the project scenario are detailed in Appendix 2: *VM0012 Quantification Equations*

The project forest inventory and spatial stratifications were created following the same stratification process outlined in Section 3.2 and the PD.

The project scenario is modeled for this monitoring period from the new 2021 LiDAR Enhanced Forest Inventory dataset which was calibrated against 2021 plot re-measurement. Forest growth and stand and carbon pool dynamics are modeled using the FVS-FFE model. Fire and harvest carbon pool dynamics are also modeled using FVS-FFE. All modeling uses the same parameters and assumptions as the baseline scenario.

For the 2022-2023 monitoring period, 65.5 ha of partial harvesting occurred on the property.

There were three fires on the Darkwoods Property in 2022, two of which covered ~702 ha of land in the Project Area. In 2023, there were four minor fires, covering ~2ha of land in the Project Area. Additionally, impacts of the 2021 fire-affected area, for which a loss report was submitted, continued to materialise into the 2022 vintage with an increase in burn severity. The associated additional effects on carbon stocks is quantified in this monitoring period.⁴⁵

⁴⁵ Outlined in CCB PD 4.1

The project GIS database was updated for the 2022-2023 fires using fire severity spatial data from BC MOF provincial fire monitoring data. This includes the fire-affected area from 2021 that continued to be further affected by the impacts into the 2022 vintage. The fire area carbon impacts of low, medium and severe fire areas were modeled by FVS-FFE SimFire option, by applying a pro-rated severity class factor to each inventory stand polygon. The no impact areas are marked in the GIS database but retain the original stand characteristics as tree mortality is low in these areas.

For the 2022-2023 period, after modifying and modeling the GIS data fire polygons, the calculation of carbon content by polygon and by carbon pool is modeled and tracked by FVS-FFE. The outputs from FVS-FFE are compiled within the Darkwoods Excel Database and summarized by the Darkwoods Carbon Model excel spreadsheet. The function these tools in relation to the calculations described in VM0012 are described further in Appendix 2.

In summary, the Darkwoods Excel was manually manipulated to take the output of the FVS-FFE modeled carbon yield curve (tracked by carbon pool, by year), for the current year status of each polygon and compiles and summarizes these data into each analysis unit by monitoring period year. FVS-FFE grows and tracks stand dynamics for each polygon and applies any project activities (i.e. harvesting, disturbances, regeneration, etc.) in each monitoring year. The FVS-FFE output was manually imported to excel to track all carbon pools, including harvested wood products. Final outputs are then summarized, and final emission reductions calculations made within the Darkwoods Carbon Model excel spreadsheet (including the calculation and addition of emissions from fossil fuels from equipment and manufacturing). The gross emissions reductions for the Project Scenario are summarized in Table 16.

Table 16: Annual emissions/reductions for the project scenario calculated for 2022-2023

Year	Ann. Project (Emissions) Reductions (tCO ₂ e)	Volume Harvested (m ³)	Project Storage HWP (tC)	Project Storage Waste Products (tC)	Project (Emissions) Production & Waste (tC)
2022	456,834	2,894	907	6	(112)
2023	219,948	8,656	1,158	30	(133)

3.2.3 Leakage Emissions (VCS, 2.5, 3.2, 3.6, 3.15, 4.3)

The project has continued to utilize the VCS leakage discount method, which is a comparison of the ratio of merchantable biomass to total tree biomass (aboveground + belowground) in the Project Area to the same ratio in an assumed likely leakage area. For this monitoring period the project has used comparable data from the project data and regional data from the Canadian National Forest Inventory (NFI)^{46 47}. The Montane Cordillera ecoregion was selected as the most representative regional area dataset from the NFI. This region (Figure 5) fully surrounds the Project Area and represents a significant regional area that has similar species and ecosystems, and also likely represents the actual comparable log markets where leakage risks might be realized.

There have been no changes to this process since the last verification other than to update the project biomass numbers to reflect 2022-2023 outputs.



Figure 5. Market Leakage Area- Montane Cordillera Ecozone

The VCS Market Leakage Factor calculations are made as follows:

1. Leakage area Total Volume:

⁴⁶ <https://nfi.nfis.org/en/biomass>

⁴⁷ https://www.ccfm.org/ci/rprt2005/English/pg59-71_2-1.htm

The Canadian NFI website (<https://nfi.nfis.org/en/biomass>) includes summary data for the Montane Cordillera Ecozone total volume, area, and average species mix:

- Total Volume using NFI Table 15.1: 8,506,990,000 cubic meters
- Forest Area using NFI Table 4.1 (Biological Diversity Tab): 34,734,110 ha
- Average Total Volume per hectare: $8,506,990,000 / 34,734,110 = 244.92$ cubic meters/ha
- Species Mix is taken from NFI Table 16.1⁴⁸:
- Top 8 species in the Montane Cordillera ecozone:
 - Engelmann spruce 26%
 - Lodgepole pine 25%
 - Fir 19%
 - D-fir 14%
 - Hemlock 6%
 - Poplar 5%
 - Cedar 3%
 - Larch 2%

The NFI website includes a calculator⁴⁹ which calculates biomass for this average stand in this ecozone from the average m³/ha and species mix above.

Inputting these data in the NFI Website Biomass Calculator outputs an average ecozone biomass volume for Total Volume = 178 tons/ha

Therefore: NFI Website Biomass Calculator Total Stand Volume converted to carbon (@0.5) = 89 tC/ha

2. Leakage Area Merchantable Volume:

⁴⁸ NFI_T16_LSAGE20_VOL_MIX_T1 (nfis.org)

⁴⁹ https://nfi.nfis.org/en/biomass_stand_merch

There is a gap in NFI data reports on the current NFI website where Merch Volume is not reported for the Montane Cordillera region (only Total Volume). Therefore, an alternative dataset that reported merch volume at the ecozone level was used from the Canadian Council of Forest Ministers reports⁵⁰:

Note that this CCFM.org dataset uses NFI data (see Table 2.1 header⁵⁰) CaFI (Canadian Forest Inventory) is the prior name for the NFI (National Forest Inventory)) and summarizes and reports the data in merch volume from 2001 by ecozone. Although older, this dataset is expected to be reasonable for the purpose of large scale regional m³/ha calculations.

Merch Volume from Table 2.1a: 5,817,410,718 m³

Forest Land from Table 1.1a (Biological Diversity Tab): 33,354,870 ha. Average Merch Volume per hectare: 5,817,410,718/33,354,870 = 174.41 m³/ha using same average species mix as above.

Inputting these data in the NFI Website Biomass Calculator outputs an average ecozone biomass volume for Merch Volume = 169 tons/ha

Therefore: NFI Website Biomass Calculator Merch Stand Volume converted to carbon (@0.5) = 84.5 tC/ha

Average Merch Carbon to Total Carbon Ratio for the leakage area (Montane Cordillera Ecozone): 84.5/89 = 0.95

Darkwoods Project Area Total and Merch Volume Comparison:

Using 2022 and 2023 Baseline Carbon Pool Data:

Merch Volume Carbon: (AgML with bark + SD) / 50,615.0 ha

Total Volume Carbon: (AgTL with bark + SD) / 50,615.0 ha

Table 17: Project Merch to Total Carbon Ratio by Year

Year	Merch tC/ha	Total tC/ha	Merch/Total
2022	22.65	39.59	0.57
2023	21.83	37.87	0.58

⁵⁰ https://www.ccfm.org/ci/rprt2005/English/pg59-71_2-1.htm

Therefore, the Leakage Area Merch/Total Ratio of 0.95% is higher than the Project Merch/Total Ratio for the leakage displacement area of 0.57 and 0.58 for each of the monitoring period years, and hence the VCS Leakage Discount Factor is 20%, as shown in Table 18.

Table 18: Annual Market Leakage Discounts for the 2022-23 monitoring period.

Year	Gross Emissions Reductions (tCO ₂ e)	Leakage Risk Discount (tCO ₂ e)	Leakage Risk % of VCU's
2022	402,981	(80,596)	20
2023	406,968	(81,394)	20

3.2.4 GHG Emission Reductions and Carbon Dioxide Removals (VCS, 3.15, 4.1)

The determination of net GHG Emissions and the associated calculation of total saleable VCUs were made following the approach and equations described in Section 4.4 of the VCS PDD. The net changes to emission reductions between the baseline and project scenario are shown in Table 20. The application of key deductions and buffer contributions to calculate claimed VCU's is also shown in Table 20. The specific calculations made to derive these values are following the PDD formulas using the Darkwoods Carbon Excel Database and Darkwoods Carbon Model spreadsheet.

Calculation of Claimed VCU's

The application of key deductions and buffer contributions to calculate claimed VCU's is shown in Table 20. The specific calculations made to derive these values are following the PD formulas and can be found in the Darkwoods Carbon Access Database Tool.

The following deductions have been made, as shown in Table 20

1. Leakage = 20%.
 - As described in Section 3.2.3
2. Uncertainty Factor = 4.5%.
 - Following the VM0012 Equations 60a-60f, a total project error (EP) of 13.0% was determined as the sum of the calculated Inventory error (EI) term of 9.5% and a model error (EM) term of 3.5%. Thus, the value of the Uncertainty Factor was determined to be 4.5% (see Table 19).
3. Non-Permanence Risk Buffer Contribution Rate = 12%

- The updated VCS Non-Permanence Risk Tool v4.2 was completed for this monitoring period, and has an increased minimum risk score of 12. The calculated risk score remains under the minimum required score; therefore, the buffer contribution rate for the project for this monitoring period is 12%.

Table 19. Uncertainty factor calculation summary

Project error by AU	
n =	74 ⁵¹
SD of Deviations =	475,143
SE of Deviations	55,234
Sum of measured values (t C) =	70,676,971
Sum of Model Deviations =	2,484,691
90% CI of Deviations =	90,860
Inventory Error (E _I) =	9.5%
Model Error (E _M) =	3.5%
Project error (E _P) =	13.0%
Uncertainty Factor =	4.5%⁵²

State the non-permanence risk rating (%)	12%
Has the non-permanence risk report been attached as either an appendix or a separate document?	☒ Yes ☒ No
For ARR and IFM projects with harvesting, state, in tCO ₂ e, the Long-term Average (LTA).	N/A. The level of harvest is below the LTA threshold defined in the Standard
Has the LTA been updated based on monitored data, if applicable?	☐ Yes ☐ No N/A

⁵¹ 75 plots were installed on the property, however, as of 2021, only 74 remain following a fire which burned one.

⁵² See supporting Darkwoods Carbon Database and related spreadsheets as referenced in DW_2022_2023_Quantification Methods doc. This value is applied in the Darkwoods Carbon Model as calculated without rounding (in this period the actual value is 1.526385977...%).

State, in tCO ₂ e, the expected total GHG benefit to date.	5,779,842
If a loss occurred (including a loss event or reversal), state the amount of tCO ₂ e lost:	No loss event in this monitoring period.

Table 20. Quantification breakdown by vintage

Vintage period	Baseline emissions (tCO ₂ e)	Project emissions (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Buffer pool allocation (tCO ₂ e)	Reductions VCU _s (tCO ₂ e) ⁵³	Removals VCU _s (tCO ₂ e)	VCUs (tCO ₂ e)
01-Jan-2022 to 31-Dec-2022	53,853	456,834	(80,596)	(46,356)	23,456	238,065	261,521
01-Jan-2023 to 31-Dec-2023	(187,020)	219,948	(81,394)	(46,982)	24,465	239,476	263,941
Total	(133,167)	676,782	(161,990)	(93,338)	47,921	477,541	525,463

Table 21. Ex-ante and ex-post comparisons

Vintage period	Ex-ante estimated reductions/removals	Achieved reductions/removals	Percent difference	Explanation for the difference
01-Jan-2022 to 31-Dec-2022	440,911	386,300	(13.2%)	Project has had multiple inventory updates, plot remeasurements, and a fire event in 2021 that resulted in a loss event. Difference in this reporting year compared to ex-ante values presented in PD is to be expected.
01-Jan-2023 to	290,837	391,517	29.5%	Project has had multiple inventory updates, plot remeasurements, and a fire event in 2021 that resulted in a loss event. Difference in this reporting year compared to

⁵³ See Appendix 3 for quantification of reductions and removals using VT0015.

31-Dec-2023				ex-ante values presented in PD is to be expected.
Total	731,748	777,817	6.1%	

3.3 Optional Criterion: Climate Change Adaptation Benefits

Not applicable; not validated at Gold Level for climate change adaption benefits.

4 COMMUNITY

4.1 Net Positive Community Impacts

4.1.1 Community Impacts (CCB, CM2.1)

The Darkwoods Property Area is the private, fee simple property with gated road access control. There are no communities, Indigenous people or other public communities or ongoing public use for income, livelihood, or critical cultural values by any people living or dependent on resources within the Property Area that would be negatively affected by project activities during this monitoring period.

There has been no material change to these assessments during this monitoring period. The below documents community user groups previously identified, the impact of the project on them, type of benefit/risk/cost, and change in wellbeing.

Community group	Community Use of the Property Area
Impact	There are 26 non-permanent recreational cabins/trailers located on a small area of the property on the Kootenay Lake known as Tye. This usage is declining (from 35 in 2013) as leases expire and are not renewed, but these leases were not affected by project activities during the monitoring period. There are a few (2-4) small (3-4 worker) exploration and mining/prospecting operators occasionally active on the property. The project implementation did not affect these users during the monitoring period; and these users do not have a material impact on carbon stocks or project activities. More generally, a limited set of people from the local communities interact directly with the Darkwoods Property Area on an intermittent basis via the opportunities listed below. • Seasonal or project-based contracting opportunities for local road construction, maintenance, and logging contractors, • Project based forest management consulting for inventory, planning, monitoring, or other project related work • Backcountry recreational use • Researchers undertaking scientific studies These users fluctuate within the monitoring period years based on project activity levels, projects, and general community usage.

Type of benefit/cost/risk	Actual, direct benefit
Change in well-being	Overall, there has been no specific changes to project activities or policies that has impacted these community users during this monitoring period.
Community group	Project Zone Community ⁵⁴
Impact	Employment on the Darkwoods Property Area: During the monitoring period NCC continued to employ 1 full time site supervisor, along with a constant level of regional and national staffing related to Darkwoods.
Type of benefit/cost/risk	Actual, direct benefit.
Change in well-being	There has been no material change to the direct employment benefits related to Darkwoods during this monitoring period.
Community group	Community Values
Impact	The CCB PD demonstrated that the local communities highly value the environment, the regions natural beauty and amenities, and the related quality of life. There is evidence that the quality of the local environment attracts people and businesses to the area, drives a high level of economic diversity into the area, and may positively benefit real estate values and other positive local community features. The Darkwoods project is a significant area that contributes directly to this amenity value for the local communities.
Type of benefit/cost/risk	Actual, direct benefit.
Change in well-being	The project has continued to provide this value to the community during this monitoring period, and although no new specific community survey data is available, regional NCC staff report that there has been no material change to these community attitudes and values during the monitoring period.
Community group	First Nations (Ktunaxa Nation, Sinixt, Okanagan and Secwepemc Nations)

⁵⁴ The CCB PD identified the Kootenay Lake Timber Supply Area (Figure 3) as a relevant spatial extent for the project zone, and no changes are proposed to this designation in this monitoring report.

Impact	Welcomed accessibility to the Property Area for traditional and cultural purposes.
Type of benefit/cost/risk	Actual, direct benefit.
Change in well-being	There has been no change to NCC's ongoing relationship with the Ktunaxa Nation during this monitoring period. There is no material ongoing use or special cultural values on the Property Area that are impacted by project activities.

4.1.2 Negative Community Impact Mitigation (VCS, 3.19; CCB, CM2.2)

No additional specific steps were necessary or taken to further mitigate negative impacts on outside stakeholders, as the expected net benefits will be positive; similar to the project zone assessment summarized in Section 4.1.1.

4.1.3 Net Positive Community Well-Being (VCS 3.19; CCB, CM2.3, GL1.4)

As there are no people or communities that live within or depend on the Property Area for their livelihoods; and there are no direct community impacts in either the with- or without-project scenarios on the Property Area. As described further in the CCB PD, in a broader project zone, the implementation of the baseline scenario would have:

- Generated economic benefits for select community members due to the increased labour and income related to higher harvesting activity levels;
- Generated negative impacts by foregoing the investment and diversified economic activities in the project scenario, negatively impacting climate services, negatively impacting other ecosystem services (including water), and negatively impacting regional amenity values that are important to community members and community development.

As noted in the CBB PD, Section G1 and G2.4, the project zone is a highly diversified modern economy that has a low dependence on forestry. Additionally, the forest industry makes up a relatively small component of the project zone economies, small component of project zone employment, and is a declining source of employment over the past several decades. During this monitoring period, the higher harvest levels in the baseline scenario would likely have expanded local forestry economic opportunities, but a substantial portion of these benefits would have accrued to stakeholders outside the project zone as a substantial volume of the harvested wood would have been delivered to external facilities.

In addition, the CCB PD discusses the fluid and flexible nature of regional log markets and regional log flows and posits that on average the market would adjust to the presence or absence of the baseline harvest volume without spiking or growing employment in a direct linear manner. In reality, the regional log markets are very interconnected, and are more reactive to national and international market conditions than by small fluctuations in local log supply. We expect in reality the higher harvest levels in the baseline scenario would result in the market deferring higher cost and/or lower quality wood sources in the regional fiber basket (particularly on long term crown tenures), or otherwise changing log flows to be more cost optimal with the Darkwoods volume in the mix rather than just expanding to the supply. That said, to be conservative (and due to lack of direct supporting evidence), for this impact analysis we have assumed the entire Darkwoods baseline harvest volume contributes additive employment and economic opportunity to the project zone in a linear fashion based on harvest volume.

Comparatively, the implementation of the project has:

- Contributed direct economic development through project activities, but negatively impacted the economic benefits of the higher timber harvesting in the baseline scenario;
- Generated substantial climate services benefits;
- Generated substantial other ecosystem services benefits, including water provisioning and quality, valuable fisheries contributions, potentially pollinator support, and other ecosystem services;
- Enhanced the community amenity values for the local region, including visual qualities, recreational opportunities, scientific study, and supporting regional environmental values and issues.

Various metrics and measures of net community impacts summarized here are provided in Section 4.3.

4.1.4 Protection of High Conservation Values (CCB, CM2.4)

As there are no communities dependent on the Property Area for well-being, there are no high conservation values (HCV) that are directly related to community well-being. The project also has not directly identified any HCV's related to community well-being in the project zone; however, the project does provide ecosystem provisioning benefits to stakeholders in the project zones, including water provisioning, fisheries contributions, potentially pollinator support and other ecosystem services.

There have been no negative impacts on these ecosystem provision services during this monitoring period as discussed below, and as supported by monitoring for biodiversity as discussed in Section 5.

4.2 Other Stakeholder Impacts

4.2.1 Mitigation of Negative Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.2)

No additional specific steps were necessary or taken to further mitigate negative impacts on outside stakeholders, as the expected net benefits will be positive; similar to the project zone assessment summarized in Section 4.1.

4.2.2 Net Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.3)

As described in the CCB PD, the impacts to offsite stakeholders can be reasonably assumed to be similar (or proportional) to the impacts to the project zone stakeholders. CCB PD data estimated 50.4%⁵⁵ of the forestry and timber processing in the project zone (Kootenay Lake TSA) accrue to stakeholders outside the project zone, and climate services, ecosystem services provisioning, and some portion of the community amenity values will also benefit stakeholders outside the project zone.

Therefore, the net benefits described in Section 4.1 and the results in Section 4.3 act as proxies for the net impact on other stakeholders outside the project zone as well. Therefore, the project implementation will be a net benefit in a manner similar to the project zone stakeholders.

There is no change to this assessment of the similarities of impacts on other stakeholders during this monitoring period and no additional unique impacts were identified during this period.

4.3 Community Impact Monitoring

4.3.1 Community Monitoring Plan (CCB, CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

Community impact monitoring is an analysis that is undertaken at each verification and calculated and reported on an annualized basis. This analysis is not undertaken on a specific date but completed as needed for a monitoring report. For this monitoring report, the analysis was undertaken in 2024 looking back on the monitoring period by year.

⁵⁵ The primary processing coefficient is calculated using Lefebvre (2008), which reported an employment coefficient of 0.655 PY/1000m³ for primary processing in the region, and noted it was difficult to isolate a specific TSA coefficient due to the amount of log trading undertaken, particularly between the Kootenay Lake, Arrow, and Columbia TSA's. In order to look more specifically at employment within the project zone, we have estimated Kootenay specific employment by extrapolating data from the BC Fiber Flow reporting (BC Ministry of Forests, 2009), which used scaling data showed 50.4% of the Kootenay Lake harvest volume is processed within the Kootenay Lake TSA: Primary processing coefficient (Lefebvre, 2008) 0.655 PY/1000m³ * 50.4% (BC MOF, 2009) = 0.327 PY/1000m³

1. Community Impact Monitoring Activity 1 - Economic/employment impact:

The monitoring for economic and employment impacts is done by re-calculating an estimate of labour and employment income generated from annual baseline and project scenario harvesting activities for the years in this monitoring report.

The same factors are applied in the CBB PD and prior monitoring periods, as shown in Table 22.

Table 22: Key Harvesting Employment Variables Within the Project Zone ^{56 57}

Average Harvested Volume (Kootenay Lake TSA; all ownerships)	640,000m ³ /year ⁵⁸
Estimated Direct Harvesting, Planning, and Silviculture Employment (Kootenay TSA)	258 PY (Person Years)
Estimated Direct Primary Processing Employment (Region wide; generated by Kootenay Lake harvest volume)	494 PY (Est. 249 PY within Kootenay Lake TSA)
Total Estimated Direct Forest Industry Employment	846 PY
Employment Coefficients:	
Harvesting/Silviculture (employment generated in Kootenay Lake TSA) ⁵⁹	0.403 PY/1000m ³
Primary Processing (employment generated in Kootenay Lake TSA) ⁶⁰	0.327 PY/1000m ³
Total employment generated from Kootenay Lake TSA harvest volume	0.73 PY/1000m ³

⁵⁶ Lefebvre, P. 2008. Central Kootenay Region Timber Harvesting and Processing Employment Survey. Final Report, December 15th, 2008. Vancouver, BC. Available online at: <http://www.for.gov.bc.ca/het/fibre.htm>

⁵⁷ IBAC. 2009. Southern Interior Beetle Action Coalition Kootenay Lake TSA Socio-Economic Trend Assessment. Merritt, BC <https://bcruralcentre.org/wp-content/uploads/2019/04/SIBAC-Submission-to-Mid-Term-Timber-Supply-Committee-July-20-2012.pdf>

⁵⁸ https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/13ts_ra_2024.pdf

⁵⁹ The harvesting/silviculture coefficient is calculated by: 258 PY / 754,953m³/yr = 0.342 PY/1000m³.

⁶⁰ The primary processing coefficient is calculated using Lefebvre (2008), which reported an employment coefficient of 0.655 PY/1000m³ for primary processing in the region, and noted it was difficult to isolate a specific TSA coefficient due to the amount of log trading undertaken, particularly between the Kootenay Lake, Arrow, and Columbia TSA's. In order to look more specifically at employment within the project zone, we have estimated Kootenay specific employment by extrapolating data from the BC Fiber Flow reporting (BC Ministry of Forests, 2009), which used scaling data showed 50.4% of the Kootenay Lake harvest volume is processed within the Kootenay Lake TSA: Primary processing coefficient (Lefebvre, 2008) 0.655 PY/1000m³ * 50.4% (BC MOF, 2009) = 0.327 PY/1000m³

Average employment income from forestry and wood processing in the Kootenay Lake TSA (2005)

\$42,630/year⁶¹

Economic/Employment Impact During this Monitoring Period:

The baseline scenario would have generated economic benefits from the significantly higher harvest levels. This harvest volume is estimated to generate ~ 220 person years of employment per year, on average, or 439.5 person years total for the monitoring period, and could generate an estimated \$9.4 million per year in employment income, or \$18.7 million over the monitoring period (calculated based on data from Table 30).

Comparatively, the project scenario harvested significantly less volume and hence generated less economic impact from harvesting (Table 23). However, the project did generate economic impacts from project spending (Table 24).

In total, and as expected, the high level of initial harvest in the baseline scenario would likely have generated more direct economic opportunity for the project zone during this monitoring period. As discussed in depth in the CCB PD, this is extremely conservative, as it assumes that the project zone forest industry would have directly and linearly expanded for each m³ in the baseline scenario, when in reality the addition of Darkwoods timber volume would not have created new jobs, but rather shifted away from lower margin log sources. This shift would be temporary and not a permanent increase.

These spending and harvest levels in both scenarios are similar to prior monitoring period results on an annualized basis.

Table 23: Direct economic benefits in this monitoring period, by scenario⁶²

Project Year	Project Harvest Volume (m ³ /yr)	Employment Generated (PY) Coefficient = 0.73	Employment Income (\$) (@Avg. \$42,630/yr)
2022	2,894	2.1	\$90,064
2023	8,656	6.3	\$269,383

⁶¹ The economic impact studies have not be updated, and although the 2005 income is likely out of date in today's dollars, this figure has been held constant due to lack of actual recent data and because it is used to create comparative numbers between scenarios on relative terms (and it allows comparison tracking consistently over time for other purposes).

⁶² NCC CCB 2022-23 - Community Valuation Exercisesv1.1.xlsx

Avg/year	5,775	4.2	\$179,724
Total	11,550	8.4	\$359,447

Project Year	Baseline Harvest Volume (m ³ /yr)	Employment Generated (PY) Coefficient = 0.73	Employment Income (\$) (@Avg. \$42,630/yr)
2022	300,046	219.0	\$9,337,402
2023	301,942	220.4	\$9,396,405
Avg/year	300,994	219.7	\$9,366,903
Total	601,988	439.4	\$18,733,806

Table 24: Additional economic benefits in the project scenario 2022-2023 (non-harvesting), converted to equivalent FTE (based on annual salary \$42,630/year)

Darkwoods – Carbon Project Expenses (NCC National)		
	2022	2023
Staff	\$63,072.17	\$58,728.80
Staff FTE	1.5	1.4
Non-staff	\$316,788.74	\$472,344.07
Non-staff FTE	7.4	11.1

Darkwoods – Conservation Project Expenses (NCC BC Regional)		
	2022	2023

Staff	\$117,938.21	\$93,673.63
Staff FTE	2.77	2.20
Non-staff	\$640,890.54	\$561,774.05
Non-Staff FTE	15.03	13.18
All Projects		
Staff	\$181,010.38	\$152,402.43
Staff FTE	4.27	3.60
Non-staff	\$957,679.28	\$1,034,118.12
Non-Staff FTE	22.43	24.28
TOTAL	\$ 1,138,689.66	\$ 1,186,520.55

2. Community Impact Monitoring Activity 2: Climate Services Impact:

The baseline scenario results in significant emissions due to timber harvesting in this monitoring period, whereas the project had very low emissions associated with harvesting. The Project Area experienced several forest fires which resulted in emissions that increased emissions in both scenarios in 2022 and 2023.

The climate impacts related to net emissions in both scenarios are estimated using a blend of carbon values (Table 25) which are used to estimate the 'social cost' of emissions and community climate benefits from emission reductions.

Over this monitoring period, the baseline generated –133,167 tCO₂e in emissions with a community climate negative cost to communities of (5,672,914) (Table 25).

Comparatively the project implementation generated substantially higher 676,782 tCO₂e of emission reduction benefits for communities, valued at \$28,830,913 (Table 25).

Note that these climate services values both represent a social cost or a proxy for 'market value' if these net climate benefits needed to be purchased by the community, but also might also represent a proxy for the potential real cost of climate change damages and adaptation to the communities over time ⁶³.

⁶³ Note we are likely being very conservative using current market price indicators (an average of CAD\$31.2/tCO₂e – the U.S. Government estimated the 'social cost of carbon' to be USD\$36.00/tCO₂e for federal agencies to weigh the costs of carbon emissions now against potential future damages from climate change (<https://obamawhitehouse.archives.gov/blog/2015/07/02/estimating->

Table 25: Darkwoods climate impact value by scenario

Net Emission Reductions by Scenario				
	Baseline	Project	Net Change	
	(tCO ₂ e/year)	(tCO ₂ e/year)	(tCO ₂ e/year)	
2022	53,853	456,834	402,981	
2023	(187,020)	219,948	406,968	
Period Total	(133,167)	676,782	809,948	
Period Average per Yr	(66,584)	338,391	404,974	
Carbon Pricing Scenarios (\$CDN)				
	BC Legislation ⁶⁴	Voluntary ⁶⁵		
Avg. \$CDN/tCO ₂ e	\$65.00	\$20.20		
Climate Services Value Estimate Scenarios (Total Period \$CDN/Year)				
	Carbon Price	Baseline	Project	Net Climate

[benefits-carbondioxide-emissions-reductions](#)). This social cost is likely a better measure for what we are calculating for community impact, but we have used a lower blended carbon benefit rate.

⁶⁴ <https://www2.gov.bc.ca/gov/content/environment/climate-change/clean-economy/carbon-tax>

⁶⁵ Based on a conservative estimate of \$15 USD, converted to CAD.

	(\$CDN/tCO ₂ e)	Net Emissions	Net Emission Reductions	Benefit
		(total \$)	(total \$)	(total \$)
BC Carbon Tax Scenario	\$65.00	(\$8,655,855)	\$43,990,830	\$52,646,685
Voluntary Market Scenario	\$20.20	(\$2,689,973)	\$13,670,996	\$16,360,970
Average Value Impact (\$/yr):	\$42.60	(\$5,672,914)	\$28,830,913	\$34,503,827

3. Community Impact Monitoring Activity 3 – Other Ecosystem Services Provisioning Impact

The project has been implemented as planned, and there have been no unplanned land use changes to the Property Area during this monitoring period that materially affect ecosystem services provisioning.

The fires that occurred during the monitoring period were of mixed severity, were unplanned and had some temporary impact on Ecosystem Services. The forests that burned are well adapted to mixed severity fires which are typical in this ecosystem.

There may have been a temporary negative impact on water quality during the fire with increased temperatures, and potentially for the three years following the fire (reduced cover will alter the timing of snowmelt and snow intercept capacity, and there is a risk of landslides that could impact water quality, but no slides have been identified).

As the burned area is within a forest type that is well adapted to and benefits from periodic mixed severity fires, Key Species Habitat and Pollinator Services would be positively impacted by the fire.

Wetlands were unimpacted by the fire because none were burned during the fire.

The qualitative assessment of non-climate ecosystem services provisioning impacts has been updated for the monitoring period, as shown in Table 26. There is no evidence of material changes to any of these assessment values during this monitoring period (as relative baseline and project scenarios) and hence the prior period and CCB PD ratings are retained.

The result for this monitoring period is the baseline scenario has a negative impact rating of -7 benefits, and a positive impact rating of +1. Comparatively the project implementation is assessed to create a positive impact rating of +10 benefits.

Table 26: Qualitative Assessment of Non-Climate Ecosystem Services Provision Impacts

Ecosystem Service	Baseline Impacts	Project Impacts	Magnitude of Value
Water Quality/Quantity	-	++ ⁶⁶	Significant ⁶⁷
Key Species Habitat	--	++	Significant ⁶⁸
Pollinator Services	-	+	Low-Moderate ⁶⁹
Recreational Hunting/Fishing	+ ⁷⁰	++ ⁷¹	Low-Significant
Outdoor Recreation	-	+	Moderate ⁷²

⁶⁶ Water quality testing has been carried out on the property and results are pending.

⁶⁷ In particular, the Darkwoods property contributes significantly to the valuable Kootenay Lake fishery, worth \$5-10 million per year to the local community (page 8:

http://www.env.gov.bc.ca/kootenay/fsh/main/pdf/KLAP%20Kootenay%20Lake%20Action%20Plan%20final%209_Ma_y_2016.pdf).

⁶⁸ In particular, the endangered mountain caribou, grizzly bears, wolverines and other key species with extensive regional planning, community involvement, and public costs. The Darkwoods project significantly contributes habitat, migration corridors, and other values to these and other species. This contributes to the success of these regional efforts and directly reduces short- and long-term community costs related to research, monitoring, habitat protection, and public land allocation/acquisitions.

⁶⁹ As discussed in the CBB PD, fully functional ecosystems in the project scenario likely support native pollinators, which may have some positive impact on local Creston Valley agriculture, either through direct pollination services or more likely contributes to species diversification, stabilizing closer populations, and providing replacement populations as necessary.

⁷⁰ Some key game species (i.e. deer) may benefit from improved browse habitat created by logging in the baseline scenario, although extensive logging may reduce other habitat attributes for such species. It is unclear whether access for hunting in the baseline scenario would have been allowed, as regional property practices are mixed. To be conservative, a positive impact rating is given.

⁷¹ The project would also benefit key game species such as deer and elk (browse in harvested areas, winter cover in retained forest, predation cover, reduced road access, etc.). The benefit to recreational fishery on Kootenay Lake may be significant, as undisturbed Darkwoods stream systems contribute directly to water quality, quantity, temperature, invertebrate populations, and fish hatchling populations into Kootenay Lake and other watersheds. NCC has allowed public hunting on parts of the property (whereas the previous owner excluded hunting) which is an additional benefit to local community.

⁷² Darkwoods provides direct benefits to 200-350 backcountry recreational users of the property each year. It is doubtful the fully operational and heavily logged property in the baseline scenario would provide a similar recreational draw.

Wetland Protection	-	+	Low ⁷³
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4. Community Monitoring Activity 4 – Community Amenity Value Impacts

The project has been implemented as planned, and there have been no unplanned land use changes to the Property Area during this monitoring period. NCC continues to be engaged with a significant number of community groups and users related to the Property Area and project activities.

No new quality of life or community environmental values surveys have been located since the detailed materials reviewed in the CCB PD. However, anecdotally, the Nelson and Creston area continues to be a highly diversified community with highly desirable quality of life features. There is also no evidence of any material shift in community values since the community surveys described in the PD. Therefore, we assess that the project fully supported community amenity values during this monitoring period.

For example, the Darkwoods Property Area supported non-motorized recreational, and backcountry use via a permit system, continued to support hunting activities, supported scientific research and projects of value to the region and communities, and continued to provide visual benefits to the Creston area and communities along the east shore of Kootenay Lake, Table 27 and Table 28 demonstrate the Darkwoods project is providing access permit opportunities for recreational and research use to local community members; and NCC is consistently engaging with recreational groups in the community. These features improve the amenity and lifestyle value for local communities, even if the economic value of that is difficult to quantify. Table 29 demonstrates the level of interest in environmental research on Darkwoods, which shows both further community engagement on carbon and biodiversity values but supports the regional interest in environmental quality and related issues. Overall, the project is having a positive impact on community amenity value which benefits local communities that would likely not have existed in the baseline scenario.

Table 27: Darkwoods public access permit monitoring results during this monitoring period

Year	# Permits
2022	10

⁷³ Significant wetlands are generally protected by minimum legal operating practices, and hence would have minor impacts from either scenario; however, the drainages into and out of wetlands and small wetlands may be impacted by logging in the baseline scenario, leading to a negative overall impact rating.

2023	14
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Table 28: Hunting Permits monitoring results during this monitoring period

Year	# Permits
2022	3
2023	4

Table 29. Scientific researchers engaged on Darkwoods during recent and current monitoring periods (partial list)

Scientific Researchers	Topic	Years
Dr. Michael Proctor	Grizzly Bears	2013-2023
Adrian Leslie	Whitebark pine	2013-2023
Marc-Andre Beaucher	Nighthawks	2015-2017
Leo DeGroot	Caribou	2013-2019
F&W Compensation Program	Bull Trout Redd Counts	2013-2023
BC Conservation Data Centre	Red and blue listed species	2016 - 2023
BC Conservation Data Centre	Western Screech Owls	2017
BC MOE	Caribou camera research project	2018-2023
Selkirk College (Dr. Brendan Wilson)	Whitebark Pine remote sensing	2019-2023
Living Lakes Canada	Water quality monitoring sites	2019-2023
Central Kootenay Invasive Species Society	Long-term invasive weeds monitoring	2018-2023
Simon Fraser University (MS Thesis)	Caribou habitat restoration	2018
Ministry of Forests, Lands and Natural Resource Operations	Caribou maternal penning project	2017
Tyson Ehlers	Macro fungi surveys	2017-2023
Carmen Scott (Selkirk College)	Lynx and Snowshoe hares	2018
BC Ministry of Forests (Dr. Michael Murray)	Whitebark Pine	2020 - 2023
Kalenna Olynyk (Central Kootenay Invasive Species Society)	Invasive plants, biological controls	2020 - 2023
Seamus Murphy	Post Fire tree regeneration	2020
Stephanie Jouvett (Selkirk College)	Whitebark Pine	2020
Arrow Lakes Stewardship Society	Post-fire seeding with drones	2022-2023
Doris Hausleitner	Wolverines	2022-2023

Khalish Frasier (Central Kootenay Invasive Species Society)	Zebra and Quagga mussel monitoring	2022-2023
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Summary of Community Net Economic Benefit Results in the Monitoring Period:

There is no impact on communities on the Property Area (no communities present).

As discussed above, project implementation has had a net positive impact on community well-being during this monitoring period,

The baseline scenario would potentially have generated a higher direct economic employment opportunity for the regional community than the project, but this is offset by the negative climate services value impact and qualitative negative impacts on other ecosystem services and community amenity values. The baseline is estimated to have a net economic impact of \$13 million and -6 qualitative negative impacts.

The project scenario generates positive direct economic employment opportunities (although less than the baseline), but also generates significant climate services value, along with qualitative additional benefits from other ecosystem services provisioning and community amenity benefits. The project is estimated to have a net economic impact of \$30 million and +7 qualitative benefits.

In net implementing the project provides a net economic benefit (net \$17 million) and net community ecosystem services and amenity services benefits.

This is a similar outcome compared to the previous monitoring period.

It should be noted that the baseline harvesting will decline significantly in 2028 as the excess timber inventory is harvested in the baseline scenario, such that the project scenario economic climate benefits will increasingly outweigh the estimate baseline economic benefits to communities over the duration of the project. In addition, as noted, the project has significant ecosystem services and amenity services value that is difficult to quantify but is highly valued by the regional communities.

Table 30: Net community benefits assessment by scenario

Property Area Estimated Net Impacts			
Baseline Scenario		Project Scenario	
# People	Direct Project Impacts	# People	Direct Project Impacts
0	None	0	None

Project Zone Net Impacts (total monitoring period, 2022-23)								
	Baseline Scenario				Project Scenario			
	Activity (Person Years)	Economic Impact (\$CDN)	# Positive Impacts	# Negat ive Impac ts	Activity (Person Years)	Economic Impact (\$CDN)	# Positive Impacts	# Negative Impacts
Employment	439.5				26			
Economic Benefit		\$18.73				\$1.27		
Climate Services Value		(\$5.67)				\$28.83		
Sub-Total Economic Value:		\$13.06				\$30.10		
Ecosystem services (net count)			0	-5			6	0
Amenity Services			0	-1			1	0
Net Services Impact Total:				-6 (-)				7 (+)

4.3.2 Monitoring Plan Dissemination (CCB, CM4.3)

The primary form of general project information distribution is through the NCC project webpages. Project implementation and Property Area activities are also communicated through meetings with key stakeholders. See additional description in Section 2.3.4 for a non-exhaustive list of stakeholder meetings during the monitoring period.

4.4 Optional Criterion: Exceptional Community Benefits

Not Applicable. Section 4.4 (including subsections 4.4.1 – 4.4.6), in its entirety, is only applicable to projects seeking Gold Level certification, which Darkwoods is not.

5 BIODIVERSITY

5.1 Net Positive Biodiversity Impacts

5.1.1 Biodiversity Changes (VCS, 3.19; CCB, B2.1)

The Darkwoods property is a site of global significance for biodiversity conservation. With a total area of 54,834.6 ha, the size of the property is significant. The current and long-term biodiversity potential is very high. To date, 277 animal and 630 plant species have been confirmed on the property⁷⁴.

The biodiversity significance of Darkwoods is partly a consequence of its geographic extent but is also related to its topographical gradient. From an elevational perspective, the property extends from warm, moist valley bottoms, to cold and dry, high elevation Engelmann spruce/Subalpine fir forests. Under the warmer climate predicted for the region, many lower elevation species are likely able to migrate upwards as their original habitat deteriorates while upslope conditions begin to ameliorate.

As part of adaptative management, NCC undertakes an extensive planning process to review and update the Darkwoods Property Management Plan every five years. As also described in the Darkwoods CCB PD, the key objectives, management plans, and monitoring plans for biodiversity for the Property Area are defined in this document. The latest updated version is the Darkwoods Conservation Area Property Management Plan 2021-2025, which was completed in 2020 and became effective in 2021 (noting these plans are internally transitioned loosely around calendar years), which is therefore the effective management plan for biodiversity in this monitoring period (2022-2023). This document provides detailed descriptions of the biodiversity effectiveness program, including targets background, references and assumptions. The updated Property Management Plan is consistent with the prior targets and desired results described in the CCB PD and the prior Property Management Plan, but it has been refined and improved based on learnings over the first two 5-year plans for the property. For clarity, updates to the initial target names found in the CCB PD tables are described in the footnotes. The names of the targets have been updated to reflect conservation standards and to better align with measurable attributes. Table 32 describes the status of each of these targets in the Baseline scenario and the Project Scenario at the start of the prior monitoring period (Jan 1, 2020) and also at the end of that monitoring period (Dec 31, 2021).

⁷⁴ Darkwoods Species List 2024

Consistent with this plan and as outlined in the previously verified deviation in Section 2.2.5, biodiversity effectiveness monitoring is undertaken similarly as in the previous Property Management Plan monitoring periods, however one material change is the transition to reporting quantitatively on a 5-year increment instead of annually to better reveal changes and trends in long term habitat and feature development. This is part of adaptive management, as NCC key staff and experts decided a 5-year reporting interval would more effectively demonstrate the long-term trends and results to inform property management improvements over time. In other words, the key biodiversity targets were not showing sufficient change on an annual basis to inform management decisions.

Annual local property management, planning and site supervision are ongoing, and provide continuous active supervision of the implementation of the Darkwoods Conservation Area Property Management Plan 2021-2025 (NCC, 2020) objectives towards achieving 5-year goals.

Table 31: Summarized status of biodiversity targets as described in the updated Darkwoods Property Management Plan (see Table 7 in the Darkwoods Property Management Plan 2020).

Biodiversity Target	Ecological Justification	Size Impact	Property Condition	Landscape Context	Viability Rank
Carbon Sequestration ⁷⁵	Mitigating the impacts of climate change	Very Good	N/A	Good	Very Good
Fire Maintained Ecosystems ⁷⁶	ICHxw and ICHdw ecosystem are rare, degraded, support many species at risk	Good	Good	Fair	Good
Hydroriparian Ecosystems / Wetlands ⁷⁷	Rare, diverse ecosystems. Support key fish populations	Good	Good	Good	Good
Mid-elevation Forests ⁷⁸	Old Growth Interior Cedar Hemlock	Very Good	Fair	Good	Good
Whitebark Pine Ecosystems ⁷⁹	Keystone species in high elevation forests. Endangered	Good	Poor	Fair	Fair

⁷⁵ New target not identified in the CCB PD (2014)

⁷⁶ Described as 'Dry ICH (Interior Cedar-Hemlock) Forest' in the CCB PD (2014)

⁷⁷ Described as 'Hydroriparian Ecosystems' in the CCB PD (2014)

⁷⁸ Described as 'Old Growth Cedar-Hemlock Forest' in CCB PD (2014)

⁷⁹ Described as 'Rare Ecosystems and Features' in the CCB PD (2014). The new terminology is more specific and measurable – the original 'rare ecosystems and features' was poorly defined and not quantifiable.

Mountain Caribou Habitat ⁸⁰	Critical habitat, highly endangered	Good	Fair	Fair	Fair
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Change in Biodiversity	% Mountain Caribou Habitat > 100 years
Monitored Change	No change has occurred during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). As per the Project Description deviation described in Section 2.2.5, NCC does not report annually on the effectiveness monitoring. This is done on a 5-year reporting schedule and is not currently due for an update in this monitoring period.

Change in Biodiversity	% Mid Elevation Forests >100 years
Monitored Change	No change has occurred during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). As per the Project Description deviation described in Section 2.2.5, NCC does not report annually on the effectiveness monitoring. This is done on a 5-year reporting schedule and is not currently due for an update in this monitoring period.

Change in Biodiversity	Area of Whitebark pine planted
Monitored Change	Area of Whitebark pine planted has increased during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). While NCC does not report annually on the effectiveness monitoring, which is done on a 5-year reporting schedule, the area of Whitebark pine is monitored on a more regular basis due to the Whitebark pine restoration project. During this monitoring period, 87,025

⁸⁰ Described as 'Mountain Caribou' in the CCB PD (2014).

	Whitebark pine seedlings were planted, increasing the area of Whitebark pine planted to 107.7 ha.
Change in Biodiversity	Grizzly Bear Habitat
Monitored Change	No change has occurred during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). As per the Project Description deviation described in Section 2.2.5, NCC does not report annually on the effectiveness monitoring. This is done on a 5-year reporting schedule and is not currently due for an update in this monitoring period.
Change in Biodiversity	Hydroriparian Ecosystems
Monitored Change	No change has occurred during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). As per the Project Description deviation described in Section 2.2.5, NCC does not report annually on the effectiveness monitoring. This is done on a 5-year reporting schedule and is not currently due for an update in this monitoring period.
Change in Biodiversity	Fire Maintained Ecosystems
Monitored Change	No change has occurred during this monitoring period.
Justification of Change	Monitoring results for 2020-2021 remain applicable for this monitoring period (Table 32). As per the Project Description deviation described in Section 2.2.5, NCC does not report annually on the effectiveness monitoring. This is done on a 5-year reporting schedule and is not currently due for an update in this monitoring period.

5.1.2 Mitigation Actions (VCS, 3.19; CCB, B2.3)

No negative impacts on biodiversity have been observed on the property during the monitoring period.

5.1.3 Net Positive Biodiversity Impacts (VCS, 3.19; CCB, B2.2, GL1.4)

In the without-project land use scenario, intense harvesting of the land would result in the destruction of diverse forest landscapes which contain within it a wealth of crucial biodiversity and associated habitats. In comparison, by implementing a reduced harvest and conservation-based regime, the project provides exceptional biodiversity benefits through the conservation and management of large-scale fully functional natural ecosystems and critical habitat for key endangered species. For example, the Darkwoods Property Area provides habitat for Mountain Caribou and Grizzly Bear, and protection of the forest allows these key species to continue to exist in the Project Zone. Additionally, avoiding harvesting of the forest will also result in improved water quality, water quantity and the associated aquatic habitats.

During this monitoring period, project activities have resulted in a small harvest of timber on the Property Area for forest health purposes.

Please see Section 5.1.1 to examine the changes in biodiversity resulting from project activities during this monitoring period. Per the deviation in section 2.2.5, biodiversity monitoring is undertaken every five years to better align with NCC's PMP and conservation best practices. The results presented for 2020-2021 remain applicable for this monitoring period. As no negative impacts have been observed, the net benefit to biodiversity is positive.

Species and habitat	Observed/confirmed in the Darkwoods Property Area
	Grizzly Bear (<i>Ursus arctos</i>) Olivesided Flycatcher (<i>Contopus cooperi</i>) Peregrine Falcon (<i>Falco peregrinus</i>) Western Toad (<i>Bufo boreas</i>) Wolverine (<i>Gulo gulo</i>) Bull Trout (<i>Salvelinus confluentus</i>)
	Likely to be found <u>adjacent</u> to the Darkwoods Property Area
	Northern Leopard Frog (<i>Lithobates pipiens</i>) Western Screech-owl (<i>Megascops kennicottii macfarlanei</i>) Yellow-breasted Chat (<i>Icteria virens</i>) American Badger (<i>Taxidea taxus</i>) Western Skink (<i>Plestiodon skiltonianus</i>) Giant Helleborine (<i>Epipactis gigantea</i>) Short-eared Owl (<i>Asio flammeus</i>) White Sturgeon (Kootenay River population) (<i>Acipenser transmontanus</i>)

	Shorthead Sculpin (<i>Cottus confuses</i>) Columbia Sculpin (<i>Cottus hubbsi</i>) Project activities have not adversely impacted habitats and areas needed for habitat connectivity for rare, threatened, or endangered species during the monitoring period, but instead has resulted in the protection of such species and their associated habitats. As the project activity involves a reduced harvest regime, compared to the without-project land use scenario, vital habitats and ecosystems which are needed for habitat connectivity are protected and improved on.
Areas needed for habitat connectivity	While a small harvest took place in the Property Area during this monitoring period, it was for forest health reasons. This helps to protect crucial areas needed for habitat connectivity in the long term.

5.1.4 High Conservation Values Protected (CCB, B2.4)

As a conservation-based project, project activities are focused away from high value conservation areas on the property, or planned in a way to minimize impacts to key biodiversity targets. During the monitoring period, NCC has continued to mitigate potential impacts to high conservation values by:

- Protecting and/or managing old growth forest areas on the property, and otherwise managing project activities away from important conservation values;
- Maintaining access control on the property through gates, access permits, and road deactivation;
- Continuing to explore opportunities for key habitat restoration/management. During this monitoring period, approximately 350,000 tree seedlings were planted, including 90,000 endangered whitebark pine. The partial harvest allowed for the restoration of key habitat and forest fuel reduction. The deactivation of roads and the biocontrol release for invasive plants also helped restore and effectively manage key habitat.
- Continuing to identify and eliminate problematic invasive species on the property (see Section 5.1.6).

The Darkwoods CCB PD (Section G1.8) generally discusses the potential high conservation values on the Property Area, including landscape level ecosystems (old growth forests), threatened or rare ecosystems (hydro-riparian ecosystems; dry interior Cedar-Hemlock (ICH) forests), critical ecosystem services (hydro-riparian ecosystems, caribou, native pollinators), local community needs, and traditional use.

As per the PD, local community needs, and traditional needs are not materially present or impacted by the project.

During this monitoring period, the project has harvested only a small volume of timber for forest health purposes, in alignment with the project activities, and hence not has not materially impacted the remaining potential high conservation values; in particular: old growth forests, ICH forests, hydro-riparian areas, and caribou habitat⁸¹.

5.1.5 Species Used (VCS, 3.19; CCB, B2.5, 2.6)

Species introduced	Classification	Justification for use	Adverse effects and mitigation
Whitebark Pine	<i>Pinus albicaulis</i>	The project has been working towards restoring at least 200 ha of Whitebark Pine ecosystem. Approximately 87,025 Whitebark Pine seedlings were planted during this monitoring period in order to work towards this goal.	No adverse effects

5.1.6 Invasive Species (VCS, 3.19; CCB, B2.5)

No known invasive species have been introduced to Darkwoods as a result of project activities during the monitoring period. Invasive species occurrence data presented in Figure 6 are available from the Invasive Alien Plant Program (IAPP)⁸², run by the BC Government's Ministry of Forests, Lands and Natural Resource Operations (FLNRO). The IAPP database contains invasive plant surveys, treatments, and activity plans for the entire province of BC. The comprehensive data in IAPP is entered by a wide variety of user groups (ministries, regional districts, weed committees,

⁸¹ Other critical species mentioned in the CCB PD include grizzly, wolverines, and native pollinators. Grizzlies and wolverines are wide ranging species that are more impacted by human road usage and landscape scale ecosystem protections (i.e. the old growth areas). Project logging does not impact these species specifically other than by proxy of minimizing widespread road usage and protecting larger scale areas of natural ecosystems. Native pollinators are widespread and also related to the general protection of larger areas of natural ecosystems, and hence are not impact by the small project harvest areas and are represented by the old growth area mapping.

⁸² <https://catalogue.data.gov.bc.ca/dataset/invasive-alien-plant-site>

forest licensees, utilities, conservation groups, federal departments and others) on an on-going basis. A . When new species are discovered, options for management are explored and treatments may be implemented. For example, a mature Black locust (*Robinia pseudoacacia*) was identified for the first time in 2023 and NCC is working with CKISS to remove this individual in 2024.

Darkwoods

Invasive Plants 2022/2023

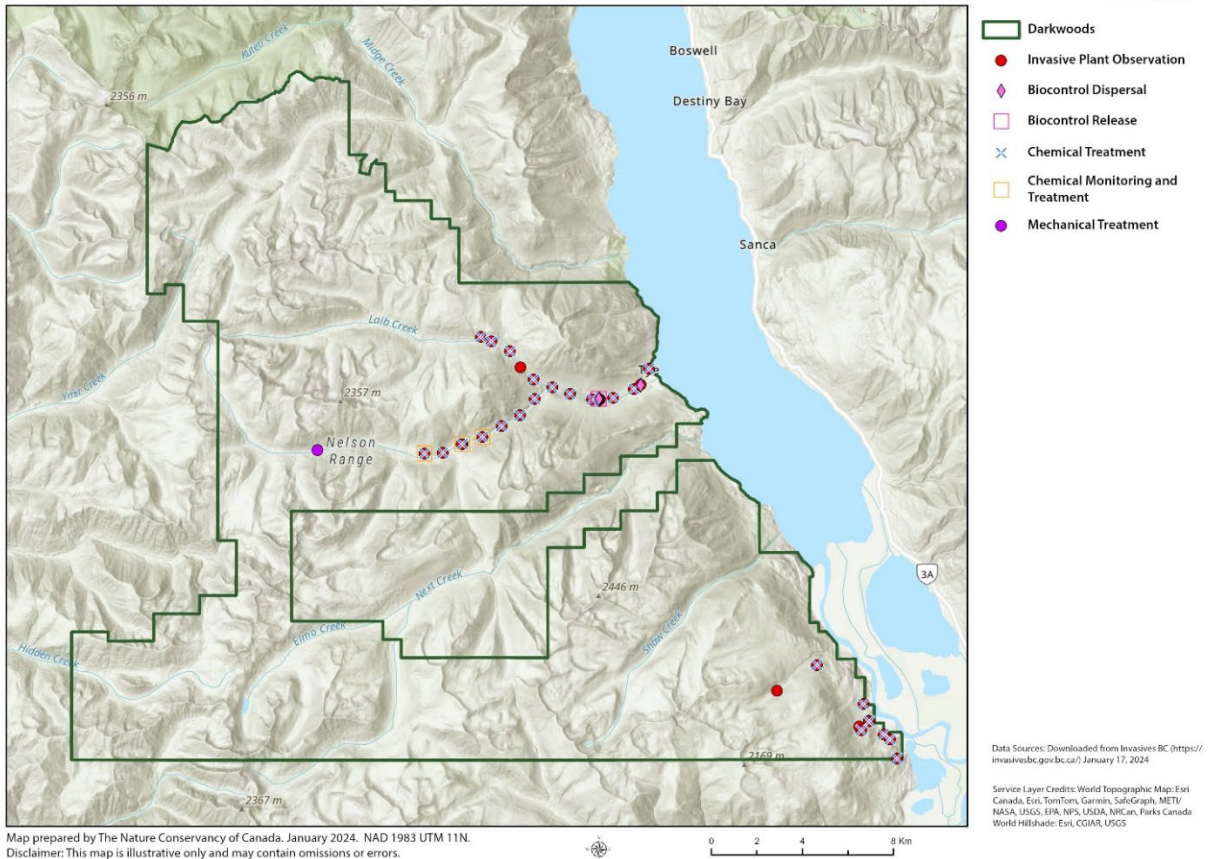


Figure 6: 2022-2023 Invasive Plant Map

NCC maintains an ongoing invasive species removal program. Invasive species almost exclusively occur along the main roads where public vehicles are present frequently. NCC monitors the presence of invasive species on a periodic basis across the property (not just the main roads, although that is where they are most likely to occur) and through informal observation and reporting by NCC staff and researchers using the property. Known invasive species are removed on a periodic or annual basis by chemical, biological, or mechanical means. Figure 6 shows the occurrence of invasive species removal activities and monitoring which were spatially recorded during the monitoring period.

Existing invasive species

Mitigation measures to prevent the spread or continued existence of invasive species

Black locust (<i>Robinia pseudoacacia</i>)	First observation occurred in 2023. NCC has removal of the species planned for 2024.
Spotted knapweed (<i>Centaurea stoebe ssp. Australis</i>)	Annual chemical spot treatment spraying along road system and continued annual monitoring.
Canada thistle (<i>Cirsium arvense</i>)	
Orange-red King Devil (<i>Hieracium aurantiacum</i>)	
Bull Thistle (<i>Cirsium vulgare</i>)	
Common St. John's-wort (<i>Hypericum perforatum</i>)	
Common Tansy (<i>Tanacetum vulgare</i>)	
Oxeye daisy (<i>Leucanthemum vulgare</i>)	
Sulphur cinquefoil (<i>Potentilla recta</i>)	Established. No treatment. No threat
Cabbage White (<i>Pieris rapae</i>)	
Thyme-leaved Sandwort (<i>Arenaria serpyllifolia</i>)	
Alfalfa (<i>Medicago sativa</i>)	
True Forget-me-not (<i>Myosotis scorpioides</i>)	
Silvery Cinquefoil (<i>Potentilla argentea</i>)	Established. No treatment. Minimal threat
Heath speedwell (<i>Veronica officinalis</i>)	
Wormwood (<i>Artemisia absinthium</i>)	Avoiding prescribed fire in Cheatgrass infested areas reduces the species ability to spread.
Cheatgrass (<i>Bromus tectorum</i>)	Very rarely observed in Property Area. Species is hand pulled when encountered.
Scotch Broom (<i>Cytisus scoparius</i>)	Has not been observed since 2009. Species is hand pulled if encountered.
Policeman's Helmet (<i>Impatiens glandulifera</i>)	Very rarely observed in Property Area. Species is hand pulled when encountered.
Himalayan Blackberry (<i>Rubus discolor</i>)	No treatment as the species poses no threat.
Sheep Sorrel (<i>Rumex acetosella</i>)	No treatment as the species poses no threat.
Curled Dock (<i>Rumex crispus</i>)	Species established in Laib Creek and have hybridized with Bull trout. No treatment is feasible.
Brook Trout (<i>Salvelinus fontinalis</i>)	

Mullein (<i>Verbascum sp.</i>)	No treatment as the species poses no threat.
Dalmatian Toadflax (<i>Linaria genistifolia ssp. Dalmatica</i>)	Hand pulled only known infestation. Possibly eradicated. Annual monitoring
Scentless chamomile (<i>Tripleurospermum inodorum</i>)	Not observed since 2013. Treated chemically. possibly eradicated.
Common evening-primrose (<i>Oenothera biennis</i>)	Rare. Hand pull when encountered
English Holly (<i>Ilex aquifolium</i>)	
Common Burdock (<i>Arctium minus</i>)	

5.1.7 GMO Exclusion (CCB, B2.7)

NCC guarantees that no GMOs were used on the Darkwoods property to generate GHG emissions reductions or removals. Seedlings planted during the monitoring period were grown by PRT – Harrop nursery⁸³, as well as Sylvan Vale Nursery Ltd who provided the Whitebark pine seedlings. PRT receives all their seeds from the Tree Seed Center of the Tree Improvement Branch in the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO). From the FLNRO Tree Improvement Branch website: (at bottom of webpage⁸⁴: “Tree Improvement Branch is not involved in any genetic engineering, gene insertion, gene splicing or biotechnology that results in genetically modified organisms. In keeping with the Government’s broad stewardship responsibilities for Crown land, Tree Improvement Branch has ensured that no genetically modified tree seed has been registered or used in operational forest planting on Crown land in British Columbia”.

5.1.8 Inputs Justification (VCS, 3.19; CCB, B2.8)

Name	Clearview Herbicide ⁸⁵
Justification of Use	Used to control invasive plant species
Adverse Effect	No risk to human health if used according to label directions

⁸³ <https://www.prt.com/contact/nursery-locations/prt-harrop>

⁸⁴ <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/treeseed/seed-production>

⁸⁵ <https://www.corteva.ca/en/products-and-solutions/crop-protection/clearview.html>

	- No risk to bodies of water, animals, pollinators or soil if used according to label directions - Potential to harm any woody or broadleaf plant that comes in direct contact with product if applied outside of target vegetation
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Name	Larinus minutus
Justification of Use	Biocontrol Used to control invasive Spotted Knapweed
Adverse Effect	No adverse effects

Name	Milestone Herbicide ⁸⁶
Justification of Use	Used to control invasive plant species
Adverse Effect	No adverse effects

5.2 Offsite Biodiversity Impacts

5.2.1 Negative Offsite Biodiversity Impacts (CCB, B3.1) and Mitigation Actions (CCB, B3.2)

Negative Offsite Impact	Mitigation Measure(s)
N/A	N/A

Not Applicable - It is exceedingly unlikely that the project will generate negative offsite biodiversity impacts. The principal objectives of the project are to promote biodiversity habitat and values. The size of the Property Area is large enough that offsite biodiversity impacts are likely to be positive rather than negative, particularly given the extensive connectivity provided by the Property Area to other protected landscapes.

5.2.2 Net Offsite Biodiversity Benefits (VCS, 3.19; CCB, B3.3)

⁸⁶ <https://www.corteva.ca/en/products-and-solutions/crop-protection/milestone.html>

In addition to the magnitude of the area encompassed by Darkwoods, the property has considerable importance because of its adjacency to, and connectivity with, three provincial protected areas. These are West Arm Provincial Park (WAPP), Midge Creek Wildlife Management Area (MCWMA), and the Creston Valley Wildlife Management Area (a 7,000 ha RAMSAR site; see s. G1.8). WAPP is an area of about 25,300 ha that extends along the shore of Kootenay Lake from Nelson to Harrop, BC and up to the peaks behind these towns. As the natural habitat for several endangered species, the area was protected for its biodiversity value and which also serves to protect Nelson's water source. The MCWMA is a 15,163 hectare protected area that provides critical lower elevation wildlife habitat for a variety of species-at-risk, including grizzly bear and mountain caribou. In totality, Darkwoods constitutes about 50% by area of a contiguous protected area of about 100,000 ha. No negative offsite biodiversity impacts of the project have been identified. The net impact on biodiversity of the project both within the project zone and in adjacent areas is positive because the protection afforded wildlife and ecosystems within the project boundary allows populations to reproduce and disperse to adjacent areas thereby allowing for more healthy populations throughout the region. For example, IUCN red-list species currently assessed as 'Endangered' or 'Vulnerable' and are found on the property are: Whitebark pine (*Pinus albicaulis*) (Endangered) and Bull Trout (*Salvelinus confluentus*) (Vulnerable). Seeds and pollen from whitebark pine on the property are naturally dispersed by birds (seeds) and wind (pollen) to adjacent areas. Similarly, streams that support Bull Trout in Darkwoods are connected to adjacent streams and populations migrate both into and out of Darkwoods.

5.3 Biodiversity Impact Monitoring

5.3.1 Biodiversity Monitoring Plan (CCB, B4.1, B4.2, GL1.4, GL3.4)

The CCB PD refers to four monitoring activities:

1. Compliance Monitoring:

NCC has complied with all regulatory and legal requirements related to the property area during this monitoring period.

2. Implementation Monitoring:

NCC has continued to implement project activities in support of the 2021-2025 Property Management Plan.

3. Effectiveness Monitoring:

With the publishing of the new 5-year Property Management Plan in 2020, NCC has shifted the reporting of quantitative measures for the Effectiveness Monitoring criteria to every 5 years (as opposed to annually as in pre-2017 monitoring periods). The main rationale for this was adaptive management – the landscape level changes being reported on many of the facets of effectiveness monitoring were not changing significantly enough on an annual basis to inform management decisions. Further, after the initial acquisition and first 10 years of management since the project start date, much of the major active management activities on the property were completed, and the ecosystems being left to re-develop or further develop in natural process (and hence annual quantitative reporting is not as effective or necessary as in prior periods). This is somewhat similar to how foresters re-measure permanent sample plots every 5-10 years so they can see real data change and trends. NCC decided a 5-year reporting period could demonstrate changes and trends on the landscape and still effectively inform future planning processes and adaptive management. Darkwoods staff continue to implement the 2021-2025 Property Management Plan and continue to actively manage and supervise the property on a daily and annual basis to confirm no material changes to conditions affecting the management activities or biodiversity targets are developing. Actions might be taken in any future monitoring period to improve short term results to biodiversity effectiveness targets or other goals on the property if deemed appropriate.

The Effectiveness Monitoring reported results shown in Table 32 are considered the effective results for each year in the 5-year period of 2021-2025, including all years in this monitoring period. No changes to the biodiversity effectiveness targets have been made during this monitoring period, and the property area appears to be on track to continue or improve the biodiversity targets through 2023.

4. Validation Monitoring:

NCC has continued to implement the plot network and 5-year remeasurement schedule as described in Section 3.1.2.

The project continues to also apply adaptive management and has been adjusting biodiversity monitoring and metrics throughout the project as described elsewhere in this document.

Table 32. Summarized Biodiversity Effectiveness Monitoring Results of the project as compared to the baseline scenario as of the end of 2021 (no new results were reporting in this monitoring period)

	Metric	Baseline at end of monitoring period (Dec 31, 2021)	Project at start of monitoring period (Jan 1, 2020)	Project at end of monitoring period (Dec 31, 2021)	Methods/Notes 2022

TARGET -VRI Comparisons					
Mountain Caribou Habitat	% of Core Habitat > 100 years	12,410 ha (49%)	14,655 ha (58%)	15,518 ha (62%)	Selected VRI stands >100 years of age clipped selected stands to target extent calculated area of clipped stands for total ha >100 within target extent divided by target extent area for percentage.
Mid Elevation Forests	% of mid elevation forest that > 100 years	5,596 ha (27.5%)	9794.9 ha (48%)	10,401 ha (51%)	Selected VRI stands >100 years of age clipped selected stands to target extent calculated area of clipped stands for total ha >100 within target extent divided by target extent area for percentage.
Fire Maintained Ecosystems	% of fire maintained ecosystem > 100 years	2,406 ha(40%)	2,816 ha (47%)	3,563 ha (59%)	Selected VRI stands >100 years of age clipped selected stands to target extent calculated area of clipped stands for total ha >100 within target extent divided by target extent area for percentage.
TARGET – Non VRI Comparisons					
Whitebark Pine Ecosystems	Area of Whitebark Pine Planted	0 ha	3.75 ha	35.26 ha (2013 and 2021)	Selected 2013 and 2021 planted polygons from NCC restoration database

Grizzly bear	% of property over 500m from an active Road.	33,135 (61%)	33,437 ha (61%)	46,154.16 ha (84.5%)	Used 500m buffer on roads marked Main line and Secondary in the "Subtype" field in the project database. For Baseline added back in the deactivated roads.
Hydro riparian	ECA Analysis	Refer to existing table of ECA values	Refer to existing table of ECA values	Refer to existing table of ECA values	

5.3.2 Biodiversity Monitoring Plan Dissemination (CCB, B4.3)

NCC uses a variety of targeted methods to disseminate project information and monitoring

results. NCC regularly publishes stories on its website and blog about the natural and conservation features of Darkwoods in order to provide information and share compelling conservation stories with the general public. Some of the latest biodiversity research and studies carried out on the Darkwoods property is posted on the NCC website, and some recent studies have included endangered whitebark pine, grizzly bear populations and wolverine denning.

More technical information related to monitoring results were shared directly to researchers and other interested stakeholder through in person meetings and direct communications. These are often two-way informational meetings where the Property Management Plan Implementation and observations are discussed along with researcher results and interests. In other words, the monitoring results are (generally) discussed in context with current information and activities rather than presented as specific reporting to target audiences. The effect, however, is the active dissemination of property progress and status to interested stakeholders. Table 33 is a non-exhaustive list of meetings used to disseminate and discuss biodiversity monitoring results and other project information, along with associated research and external group interests and results.

Table 33. Representative list of project-related meetings and events over the monitoring period

Date	Staff Presenter	Event	Topic	Location	Audience	# of Attendees
Jun 2022	Adrian Leslie	Technical Project Planning	Ecosystem Restoration Project workshop - Darkwoods Whitebark Restoration	Virtual	Columbia Basin Trust, Kootenay Conservation	79

		Workshop - webinar			Program partners - non- profit groups	
Sep 2022	Nancy Newhouse	Public Outreach – Presentations (not science)	Keynote Presentation	Creston	Kootenay Conservation Program Partners	40
Nov 2022	Adrian Leslie	Public Outreach - speaker, panel, lecture	South Selkirks - Lower Columbia Conservation Action Forum. Darkwoods fire management	Trail	Stakeholders and partner organizations	47

5.4 Optional Criterion: Exceptional Biodiversity Benefits

IUCN red-list species currently assessed as ‘Endangered’ or ‘Vulnerable’ which are found on the property are: **Whitebark pine** (*Pinus albicaulis*) (Endangered) and **Bull Trout** (*Salvelinus confluentus*) (Vulnerable). An additional 33 provincially red or blue listed species have been confirmed on Darkwoods since 2008⁸⁷.

5.4.1 Trigger Species Population Trends (CCB, GL3.2, GL3.3)

Trigger Species	Whitebark pine (<i>Pinus albicaulis</i>) - Endangered
With-project Scenario	Whitebark Pine is experiencing serious decline due to White Pine Blister Rust (WPBR) and Mountain Pine Beetle (MPB) ⁸⁸ . The species exists throughout the Property Area and implementation of project activities such as the protection of vital habitat from degradation or destruction, and forest health maintenance, helps maintain and enhance the population of Whitebark Pine in the Property Area. During this monitoring period and in line with the PMP, the project has been working towards restoring at least 200 ha of Whitebark Pine ecosystem. These efforts included planting 87,025 Whitebark Pine seedlings during the monitoring period (Section 5.1.4) and a meeting that took place during this monitoring period related to Whitebark Pine restoration (Table 28).

⁸⁷ Darkwoods Species List 2024

⁸⁸ <https://www.iucnredlist.org/species/39049/2885918#assessment-information>

Trigger Species	Bull Trout (<i>Salvelinus confluentus</i>) - Vulnerable
With-project Scenario	In line with the “Vulnerable” designation under the IUCN red-list, most populations of Bull Trout in Canada are of special concern. Bull Trout are particularly susceptible to human disturbance, especially habitat loss through degradation and fragmentation. Streams and lakes in the Property Area support healthy populations of Bull Trout and protection of riparian areas through the project activities is helping to maintain and enhance the population of Bull Trout in the area during this monitoring period.

APPENDIX 1: PROJECT RISKS TABLE

	Identified risk(s)	Potential impact of risk on stakeholders, ecosystem health, and biodiversity	Mitigation or preventative measure(s) taken
Natural and human induced risks to stakeholders' wellbeing	No risk identified		There are no communities, indigenous people or other public communities or ongoing public use for income, livelihood, or critical cultural values by any people living or dependent on resources within the Property Area that would be affected by project activities during this monitoring period.
Risks to stakeholder participation	No risk identified		
Working conditions	No risk identified		
Safety of women and girls	No risk identified		
Safety of minority and marginalized groups, including children	No risk identified		
Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	No risk identified		
Discrimination	No risk identified		

Sexual harassment	No risk identified		There are no communities, indigenous people or other public communities or ongoing public use for income, livelihood, or critical cultural values by any people living or dependent on resources within the Property Area that would be affected by project activities during this monitoring period.
Equal pay for equal work	No risk identified		
Gender equity in labor and work	No risk identified		
Forced labor⁸⁹	No risk identified		
Child labor	No risk identified		
Human trafficking	No risk identified		
Recognition of, respect of, and promotion of the rights to IPs, LCs and customary rights holders	No risk identified		
Preserving and protecting cultural heritage	No risk identified		

⁸⁹ The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

Protecting and preserving property rights, customary rights, or protecting legal or customary tenure/access rights to territories, property, and resources, including collective and/or conflicting rights	No risk identified		There are no individuals, communities, Indigenous people or public users that derive income or are dependent on the Property Area. The project activities did not cause any risk in this monitoring period.
Impacts on biodiversity and ecosystems	No risk identified		
Soil degradation and soil erosion	No risk identified		
Water consumption and stress	No risk identified		
Habitats (and areas needed for habitat connectivity) for rare, threatened, and endangered species	No risk identified		
Areas needed for habitat connectivity	No risk identified		
Invasive species	No risk identified		
Ecosystem conversion	No risk identified		
[Additional risk identified]	No risk identified		

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APPENDIX 2: VM0012 QUANTIFICATION EQUATIONS

The following is a list of the carbon calculation equations required by the methodology VM0012 with notes and references to connect to the model process and tools used to complete each calculation. The equations and numbering are related to the VM0012 v1.2 methodology document unless otherwise noted. Comments related to the how each equation is accomplished in this monitoring period is added in green text:

Calculating the Carbon Balance

The total annual carbon balance for each inventory polygon within the project landbase is tracked using the FVS-FFE model for each polygon. The annual carbon content (tracked for each ecosystem pool) is then summed each year for the whole landbase in baseline scenario by FVS, and then summarized in the Darkwoods Carbon Model spreadsheet ((Equations 1-3, 10). The annual change in harvested wood products storage (Equations 2, 18) is calculated in the Darkwoods Carbon Model sheet (see below) using the annual simulated harvested wood volume output from FVS-FFE to drive the calculations.

BASELINE EMISSIONS EQUATIONS: The total annual carbon balance in year, t, for the baseline scenario is calculated as ($\Delta C_{BSL,t}$, in t C yr⁻¹):

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

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.

Change in carbon stocks by pool by year is modeled by FVS-FFE by inventory polygon, and summarized across the project area. The annual carbon content (tracked by carbon pool) is then summed each year for the project area for the Baseline scenario by FVS, and then the output summarized in the Darkwoods Carbon Model spreadsheet by monitoring year to complete equation 1.

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

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.

FVS models changes in carbon stocks by pool by inventory polygon, which is then compiled and summarized by year, polygon and across the BSL scenario conditions. The FVS stand data (Stand Carbon Report) outputs by pool are imported to the Darkwoods Carbon Excel Sheet where the data is compiled by polygon and year for the Baseline scenario to complete equation 2.

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

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.

FVS-FFE models live tree gains and loss by inventory polygon, by carbon pool, and by year based on the 2022 LiDAR forest inventory stand data and annual baseline activities and stand dynamics. The Darkwoods Database tool compiles and summarizes the FVS-FFE carbon outputs across polygons and baseline scenario conditions, including calculating Equation 3.

Live biomass gain in year, t, polygon, i ($\Delta C_{BSL,G,i,t}$) is calculated as:

$$\Delta C_{BSL,G,t} = S(A_{BSL,i} \bullet G_{BSL,i,t}) \bullet CF \quad (4)$$

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).

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

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);

$$G_{BSL,BG,i,t} = G_{BSL,AG,i,t} \bullet Ri \quad (5b)$$

The total annual live biomass gain for each polygon, i within the project landbase is tracked by FVS-FFE for each polygon, and across the project area for the Baseline scenario by year. FVS-FFE determines the amount of C storage in each inventory polygon by carbon pool, including modeling tree growth based on stand inventory tree data and using algorithms calibrated for forests in the IE Variant and other site specific stand data (i.e. polygon elevation, aspect, lat/long, etc.). The FVS-FFE carbon table provides values in tC/ha which are then converted to total tons by multiplying by the area of the polygon (Equation 4). The amount carbon stored in above and below ground live biomass is calculated and tracked annually by FVS-FFE (Equations 5a-b).

Live biomass loss is calculated as:

$$\Delta C_{BSL,L,t} = S(LBL_{BSL,NATURAL,i,t} + LBL_{BSL,FELLINGS,i,t} + LBL_{BSL,OTHER,i,t}) \bullet CF \quad (6)$$

where:

$LBL_{BSL,NATURAL,i,t}$ = 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).

$$LBL_{BSL,NATURAL,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,NATURAL,i,t} \quad (7)^{90}$$

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 < $f_{BSL,NATURAL,i,t}$ < 1), year, t.

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

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 < $f_{BSL,HARVEST,i,t}$ < 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.

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

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 < $f_{BSL,DAMAGE,i,t}$ < 1).

The total annual live biomass loss for each polygon, i within the project landbase (Equations 6-8) is tracked using the FVS-FFE model by year, and then summarized across the project area for the Baseline scenario by year. Within-stand losses related to natural mortality and stand-self thinning are modeled and tracked within FVS-FFE for each polygon based on polygon tree data from inventory and algorithms calibrated for the IE Variant and other site specific polygon data (i.e. polygon elevation, aspect, lat/long, etc.). Live biomass loss through harvesting is represented using the harvest schedule determined by the FPS model and implemented in FVS-FFE by polygon on an annual basis. When this occurs, the polygon has its age reset to 1 and switches to the associated regenerating stand analysis unit. Regeneration is modeled as natural regeneration. Live biomass loss due to fire and other natural disturbances (if applicable to the baseline scenario) are modeled using FVS-FFE sub-routines based on ex-post inventory updates by polygon applied to that years modeled baseline forest inventory. FVS-FFE then models live biomass loss and other carbon pool changes and dynamics by fire severity class, by polygon, by carbon pool. FVS-FFE resumes stand growth and

⁹⁰ Note, for Equation 7, 8, and 9: ($f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t}$) ≤ 1.0

development and carbon pool dynamics based on the modeled outcome of the fire on affected polygons on an annual basis.

Change in Dead Organic Matter (DOM) ($\Delta C_{BSL,DOM,t}$; t C yr⁻¹) is calculated as:

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

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.

The change in DOM derived from lying dead wood (LDW) carbon stock in year, t (t C yr⁻¹) is calculated as:

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

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

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).

$$\begin{aligned} LDW_{BSL,IN,i,t} = & (LBL_{BSL,NATURAL,i,t} - LBL_{BSL,NATURAL,i,t} \bullet Ri) \bullet f_{BSL,BLOWDOWN,i,t} + ((LBL_{BSL,FELLINGS,i,t} - \\ & LBL_{BSL,FELLINGS,i,t} \bullet Ri) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri)) \bullet f_{BSL,BRANCH,i,t} + ((LBL_{BSL,FELLINGS,i,t} - \\ & LBL_{BSL,FELLINGS,i,t} \bullet Ri) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri)) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet f_{BSL,BUCKINGLOSS,i,t} + \\ & SNAG_{BSL,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t} \end{aligned} \quad (12)$$

where:

$LBL_{BSL,NATURAL,i,t}$, $LBL_{BSL,FELLINGS,i,t}$, and $LBL_{BSL,OTHER,i,t}$ are as calculated in equations 7, 8, and 9, respectively.

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

$f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t (unitless; $0 < f_{BSL,SNAGFALLDOWN,i,t} < 1$).

$f_{BSL,BRANCH,i,t}$ = the annual proportion of aboveground tree biomass comprised of branches > 5 cm diameter in polygon, i (unitless; $0 < f_{BSL,BRANCH,i,t} < 1$).

$f_{BSL,BUCKINGLOSS,i,t}$ = 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; $0 < f_{BSL,BUCKINGLOSS,i,t} < 1$).

$f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, i, year, t, that falls over and thus is transferred to the LDW pool (unitless; $0 < f_{BSL,SNAGFALLDOWN,i,t} < 1$).

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

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; ; $0 < f_{BSL,lwDECAY,i,t} < 1$).

The change in DOM derived from standing dead wood (snag) carbon stock in year, t (t C yr⁻¹) is calculated as:

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

$$SNAG_{BSL,i,t+1} = SNAG_{BSL,i,t} + (SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t}) \quad (14b)$$

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.

$$SNAG_{BSL,IN,i,t} = (LBL_{BSL,NATURAL,i,t} - LBL_{BSL,NATURAL,i,t} \bullet Ri) \bullet (1 - f_{BSL,BLOWDOWN,i,t}) \quad (15)$$

where:

$LBL_{BSL,NATURAL,i,t}$ 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; $0 < f_{BSL,BLOWDOWN,i,t} < 1$).

$$SNAG_{BSL,OUT,i,t} = SNAG_{BSL,i,t} \bullet f_{BSL,SWDECAY,i,t} + SNAG_{BSL,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t} \quad (16)$$

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; $0 < f_{BSL,SWDECAY,i,t} < 1$).

$f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, i, that falls over and thus is transferred to the LDW pool (unitless; $0 < f_{BSL,SNAGFALLDOWN,i,t} < 1$).

The annual change in DOM derived from dead belowground biomass ($\Delta C_{BSL,DBG,i,t}$; t C yr⁻¹) is calculated for each polygon as:

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

$$DBG_{BSL,i,t+1} = DBG_{BSL,i,t} + (DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \quad (17b)$$

where:

$DBG_{BSL,IN,i,t}$ = 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).

$$DBG_{BSL,IN,i,t} = [(ABSL_i \bullet LB_{BSL,i,t} \bullet Ri) \bullet (f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t})] \quad (17c)$$

where:

$ABSL_i$ = 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 $ABSL_i$, the area (ha) of forest land in polygon, i.

Ri 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; $0 < f_{NATURALi} < 1$), year, t (see equation 7),

$f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 < f_{HARVESTi} < 1$), 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; $0 < f_{DAMAGE,i,t} < 1$), year, t (see equation 9)

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

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; $0 < f_{BSL,dgbDECAY,i,t} < 1$).

Dead organic matter dynamics including dead wood and snag creation and decay are simulated and tracked by carbon pool using FVS-FFE for each polygon, by year; and then summarized across project area as needed within the Darkwoods Carbon Excel Sheet. Dead organic matter dynamics (i.e. recruitment, decay, etc.) are modeled and tracked within FVS-FFE for each polygon based on polygon tree data from inventory and growth, mortality, and decay algorithms calibrated for the IE Variant and other site specific polygon data (i.e. polygon elevation, aspect, lat/long, etc.). FVS-FFE also models dead organic matter dynamics as it relates to

harvesting and natural disturbances as noted above. Thus, Equations 10-17 are captured within the carbon curves generated by FVS-FFE for each analysis unit and tracked on the landbase.

Harvested Wood Products

The annual change in emissions associated with the production of harvested wood products (HWP) is calculated as:

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

Where:

$\Delta C_{BSL,STORHWP,t}$ = 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.

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:

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

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 $t2$: 1,2,3... t years elapsed

since the project start date

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

where:

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

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

$L_{BSL,OTHER,i,h}$ = 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)

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

h = harvest period ; yr

$$C_{BSL, \text{MILL}, h, k} = (C_{BSL, \text{TIMBER}, h, k} \bullet f_{\text{RND}, k} \bullet r_{\text{RND}, k}) \quad (21)$$

where:

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

$C_{BSL, \text{TIMBER}, h, k}$ = 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) $f_{\text{RND}, k}$ = 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

$r_{\text{RND}, k}$ = 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

For each product type, k : the short-lived fraction ($P_{BSL, \text{SLF}, k}$), medium-lived fraction ($P_{BSL, \text{MLF}, k}$), and longlived fraction ($P_{BSL, \text{LLF}, k}$) are calculated as:

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

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

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

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

where:

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

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)

Fossil fuel emissions from equipment and manufacturing:

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

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

where:

$C_{BSL, \text{EMITHARVEST}, t}$ 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)

$$C_{BSL,EMITHARVEST,t} = S[(L_{BSL,FELLINGS,i,t} - L_{BSL,FELLINGS,i,t} \bullet R_i + L_{BSL,OTHER,i,t} - L_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet c_{HARVEST} \quad (25)$$

where:

$c_{HARVEST}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting; all other terms are as defined in equation 20.

$$C_{BSL,EMITTRANSPORT,t} = S[(L_{BSL,FELLINGS,i,t} - L_{BSL,FELLINGS,i,t} \bullet R_i + L_{BSL,OTHER,i,t} - L_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet S(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk}) \quad (26)$$

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 ; all other terms are as defined in equation 20.

$$C_{BSL,EMITMANUFACTURE,t} = S[(L_{BSL,FELLINGS,i,t} - L_{BSL,FELLINGS,i,t} \bullet R_i + L_{BSL,OTHER,i,t} - L_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet S(f_{BSL,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF \quad (27)$$

Where:

$c_{MANUFACTUREk}$ 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 20.

FVS-FFE models the transition of carbon removed from each polygon during harvest into the Harvested Products Report. FVS calculates and tracks harvested wood products pools following the VCS reference 1605b documentation required by VCS, including the modeling of HWP pool decay by product type, by short, medium, and long term HWP pool, and by year. Note that also FVS-FFE outputs and tracks carbon storage and emissions in the landfill pool. Although VCS provides optional guidance to combine this pool with HWP, the landfill pool amounts are minimal and the complexity to add these back to the HWP by product type is very high (and not possible within FVS-FFE itself). Therefore the landfill pool is excluded, which is consistent with the HWP tracking equations in VM0012 and requirements of VCS.

Note that in the monitoring period the HWP pool data and related dynamics from the prior periods (2020-2021) were incorporated along with the new HWP data.

Fossil fuel emissions from equipment and manufacturing calculations are made separately in the Darkwoods Carbon Model; worksheet: Summary Tables and Figures, using output data from the Harvested Wood Report in FVS-FFE and scheduled harvest volumes from FPS, by year. Key

assumptions used for the Darkwoods project in the Darkwoods Carbon Model spreadsheet follow the PD recommendations and are documented at the top of the calculation spreadsheet.

PROJECT EMISSIONS EQUATIONS:

Actual (ex post) annual net carbon stocks are calculated using the equations in this section.

$$\text{CACTUAL}_{i,t} = \text{CLB}_{i,t} + \text{CDOM}_{i,t}$$

(28a)

where:

$\text{CACTUAL}_{i,t}$ = carbon stocks in all selected carbon pools in polygon, i , year, t ; t C

$\text{CLB}_{i,t}$ = carbon stocks in living tree biomass in polygon, i , year, t ; t C

$\text{CDOM}_{i,t}$ = carbon stocks in dead organic matter in year, t ; t C

Live biomass

$$\text{BTOTAL}_{i,t} = (\text{BAG}_{i,t} + \text{BBG}_{i,t}) \quad (28b)$$

$$\text{CLB}_{i,t} = (\text{BTOTAL}_{i,t}) \bullet \text{CF}$$

(28c)

where:

$\text{BAG}_{i,t}$ = aboveground tree biomass (t d.m. ha⁻¹) measured in polygon, i , year, t

$\text{BBG}_{i,t}$ = belowground tree biomass (t d.m. ha⁻¹) measured in polygon, i , year, t .

$\text{BTOTAL}_{i,t}$ = total tree biomass (t d.m. ha⁻¹) measured in polygon, i , year, t

$$\text{BBG}_{i,t} = \text{BAG}_{i,t} \bullet \text{Ri} \quad (28d)$$

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

Dead organic matter

Carbon stored in dead organic matter pools in measured polygon, i , year t , ($\text{CDOM}_{i,t}$) is calculated as the sum of that stored in lying dead wood and standing snags.

$$\text{CDOM}_{i,t} = (\text{DOM}_{\text{LDW},i,t} + \text{DOM}_{\text{SNAG},i,t}) \bullet \text{CF} \quad (28e)$$

where:

$\text{DOM}_{\text{LDW},i,t}$ = average mass of dead organic matter contained in lying dead wood (t d.m. ha⁻¹) in measured in polygon, i , year, t

$\text{DOM}_{\text{SNAG},i,t}$ = 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 ($\text{DOM}_{\text{LDW},i,t}$) is calculated according to equations 60a-c).

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

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

where:

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

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

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, $t\ C\ yr^{-1}$.

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

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; $t\ C\ yr^{-1}$.

If the project area has been stratified, carbon pools are calculated for each polygon, i , and then summed during a given year, t .

As in the baseline scenario calculations, the change in carbon stocks by pool, by year is modeled by FVS-FFE by inventory polygon, and then summarized across the project area. For the project scenario, the ex-post calculations are made after updating the forest inventory for any project activities or natural disturbances, which are then incorporated into the FVS-FFE modeling and tracking. The annual carbon content (tracked by carbon pool) is then summed each year for the project area for the Project scenario by FVS-FFE, and the output compiled in Darkwoods Carbon Summary Excel sheet, and then summarized in the Darkwoods Carbon Model spreadsheet by monitoring year.

Live biomass gain in year, t , polygon, i ($\Delta C_{PRJ,G,i,t}$) is calculated as:

$$\Delta C_{PRJ,G,t} = S(APRJ,i) \bullet GPRJ,i,t \bullet CF \quad (32)$$

where:

$APRJ,i$ = area (ha) of forest land in polygon, i ;

$GPRJ,i,t$ = 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).

$$GPRJ,i,t = GPRJ,AG,i,t + GPRJ,BG,i,t \quad (33a)$$

Where

$GPRJ,AG,i,t$ and $GPRJ,BG,i,t$ are the annual above- and belowground biomass increment rates ($t\ d.m.\ ha^{-1}\ yr^{-1}$);

$$GPRJ,BG,i,t = GPRJ,AG,i,t \bullet R_i \quad (33b)$$

where

R_i is the root:shoot ratio in polygon, i .

Equations 32 and 33 can be used directly to calculate $\Delta C_{PRJ,G,t}$ when all tree cover within a

FVS-FFE models live tree gains and loss by inventory polygon, by carbon pool, and by year based of the forest inventory stand data (updated for annual project activities) and stand and carbon pool dynamics. The Darkwoods Excel Sheet compiles and summarizes the FVS-FFE carbon outputs across polygons and baseline scenario conditions, including calculating Equation 3.

Live biomass loss ($\Delta C_{PRJ,L,t}$; $t\ C\ yr^{-1}$) is the sum of losses from:

$$\Delta C_{PRJ,L,t} = S(LBL_{PRJ,NATURALi,t} + LBL_{PRJ,FELLINGS,i,t} + LBL_{PRJ,OTHERi,t}) \bullet CF \quad (34)$$

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 ; $t\ d.m.\ yr^{-1}$

$LBL_{PRJ,OTHERi,t}$ = 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).

$$LBL_{PRJ,NATURALi,t} = APRJ,i \bullet LBPRJ,i,t \bullet f_{PRJ,NATURAL,i,t} \quad (35)$$

where:

$APRJ,i$ = area (ha) of forest land in polygon, i ;

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

$LBPRJ,i,t$ is calculated for year, t , beginning with biomass estimates in year $t=1$ (the project start year) and with annual biomass increments ($GPRJ,i,t$) 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 .

$$LBL_{PRJ,FELLINGS,i,t} = APRJ,i \bullet LBPRJ,i,t \bullet f_{PRJ,HARVEST,i,t} \quad (36)$$

where:

$APRJ,i$ = area (ha) of forest land in polygon, i

$LBPRJ,i,t$ = 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; $0 \leq f_{PRJ,HARVESTi} \leq 1$), in year, t .

$$\text{LBLPRJ,OTHER},i,t = \text{APRJ},i \bullet \text{LBPRJ},i,t \bullet \text{fPRJ,HARVEST},i,t \bullet \text{fPRJ,DAMAGE},i,t \quad (37)$$

where:

APRJ,i = area (ha) of forest land in polygon, i ;

LBPRJ,i,t = average live tree biomass (t d.m. ha⁻¹) in polygon, i , for year, t $\text{fPRJ,HARVEST},i,t$ = the proportion of biomass removed by harvesting from polygon, i , in year, t (unitless; $0 \leq \text{fPRJ,HARVEST},i,t \leq 1$).

$\text{fPRJ,DAMAGE},i,t$ = the proportion of additional biomass removed for road and landing construction in polygon, i , year, t (unitless; $0 \leq \text{fPRJ,DAMAGE},i,t \leq 1$).

The total annual live biomass loss for each polygon, i within the project landbase is modeled and tracked FVS-FFE, by year, and then summarized across the project area for the Project scenario to accomplish Equation 32 - 37. Within-stand losses related to natural mortality and stand self-thinning are modeled and tracked within FVS-FFE for each polygon based on polygon inventory tree data and algorithms calibrated for the IE Variant and other site specific polygon data (i.e. polygon elevation, aspect, lat/long, etc.). Live biomass loss through harvesting is determined based on actual ex-post project activities updated to the forest inventory by polygon and incorporated into the FVS-FFE modeling. Similarly live biomass loss due to natural disturbances such as fire are based on ex-post inventory updates, in combination with FVS-FFE fire modeling sub-routines based on fire severity class. Project harvest and fire removals and related stand carbon pool changes are modeled and tracked by FVS-FFE for any harvested polygon in year t .

Dead Organic Matter DOM ($\Delta\text{CPRJ,DOM}$; t C yr⁻¹) is calculated as:

$$\Delta\text{CPRJ,DOM},t = \Delta\text{CPRJ,LDW},t + \Delta\text{CPRJ,SNAG},t + \Delta\text{CPRJ,DBG},t \quad (38)$$

where:

$\Delta\text{CPRJ,LDW},t$ = change in lying dead wood (LDW) carbon stocks in year, t ; t C yr⁻¹

$\Delta\text{CPRJ,SNAG},t$ = change in snag carbon stock in year, t ; t C yr⁻¹

$\Delta\text{CPRJ,DBG},t$ = change in belowground carbon stock in year, t ; t C yr⁻¹.

The change in DOM derived from lying dead wood (LDW) carbon stock in year, t (t C yr⁻¹) is calculated as:

$$\Delta\text{CPRJ,LDW},t = \text{S}(\text{LDWPRJ,IN},i,t - \text{LDWPRJ,OUT},i,t) \bullet \text{CF} \quad (39a)$$

$$\text{LDWPRJ},i,t+1 = \text{LDWPRJ},i,t + (\text{LDWPRJ,IN},i,t - \text{LDWPRJ,OUT},i,t) \quad (39b)$$

where:

LDWPRJ,i,t = The total mass of lying dead wood accumulated in polygon i at time t (t d.m.).

$\text{LDWPRJ,IN},i,t$ = 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.

$\text{LDWPRJ,OUT},i,t$ = annual loss in LDW biomass through decay, for polygon i , year, t , (t d.m ha⁻¹ yr⁻¹)

$\text{LDWPRJ,IN},i,t$ and $\text{LDWPRJ,OUT},i,t$ are summed across polygons.

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

$$\begin{aligned} \text{LDWPRJ,IN},i,t = & (\text{LBLPRJ,NATURALI},i,t - \text{LBLPRJ,NATURALI},i,t \bullet \text{Ri}) \bullet \text{fPRJ,BLOWDOWN},i,t + \\ & ((\text{LBLPRJ,FELLINGS},i,t - \text{LBLPRJ,FELLINGS},i,t \bullet \text{Ri}) + (\text{LBLPRJ,OTHER},i,t - \text{LBLPRJ,OTHER},i,t \bullet \text{Ri})) \bullet \\ & \text{fPRJ,BRANCH},i,t + ((\text{LBLPRJ,FELLINGS},i,t - \text{LBLPRJ,FELLINGS},i,t \bullet \text{Ri}) + (\text{LBLPRJ,OTHER},i,t - \\ & \text{LBLPRJ,OTHER},i,t \bullet \text{Ri})) \bullet (1 - \text{fPRJ,BRANCH},i,t) \bullet \text{fPRJ,BUCKINGLOSS},i,t + \text{SNAGPRJ},i,t \bullet \\ & \text{fPRJ,SNAGFALLDOWN},i,t \end{aligned} \quad (40)$$

where:

LBLPRJ,NATURALI,t, LBLPRJ,FELLINGS,i,t, and LBLPRJ,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).

fPRJ,BLOWDOWN,i,t = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, *i*, year, *t* (unitless; $0 \leq \text{fPRJ,BLOWDOWN},i,t \leq 1$).

fPRJ,BRANCH,i,t = the annual proportion of aboveground tree biomass comprised of branches ≥ 5 cm diameter in polygon, *i* (unitless; $0 \leq \text{fPRJ,BRANCH},i,t \leq 1$).

fPRJ,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; $0 \leq \text{fPRJ,BUCKINGLOSS},i,t \leq 1$).

SNAGPRJ,i,t = the total mass of the snag pool in polygon, *i*, year, *t* (see equation 42b).

fPRJ,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; $0 \leq \text{fPRJ,SNAGFALLDOWN},i,t \leq 1$).

$$\text{LDWPRJ,OUT},i,t = \text{LDWPRJ},i,t \bullet \text{fPRJ,IWDECAY},i,t \quad (41)$$

where:

LDWPRJ,i,t = the total amount of lying deadwood mass in polygon *i*, year, *t* (see equation 39b).

fPRJ,IWDECAY,i,t = the annual proportional loss of lying dead biomass due to decay, in polygon *i*, year, *t* (unitless; $0 \leq \text{fPRJ,IWDECAY},i,t \leq 1$).

The change in standing dead wood (snag) carbon stock in year, *t* (t C yr⁻¹) is calculated as:

$$\Delta \text{CPRJ,SNAG},t = \text{S}(\text{SNAGPRJ,IN},i,t - \text{SNAGPRJ,OUT},i,t) \bullet \text{CF} \quad (42a)$$

$$\text{SNAGPRJ},i,t+1 = \text{SNAGPRJ},i,t + (\text{SNAGPRJ,IN},i,t - \text{SNAGPRJ,OUT},i,t) \quad (42b)$$

where:

SNAGPRJ,i,t = The total mass of snags accumulated in polygon *i* at time *t* (t d.m.)

SNAGPRJ,IN,i,t = annual gain in snag biomass for polygon *i*, year, *t* (t d.m ha⁻¹ yr⁻¹).

SNAGPRJ,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 SNAGPRJ,IN,i,t and SNAGPRJ,OUT,i,t are summed across polygons.

$$\text{SNAGPRJ,IN},i,t = (\text{LBLPRJ,NATURALI},i,t - \text{LBLPRJ,NATURALI},i,t \bullet \text{Ri}) \bullet (1 - \text{fPRJ,BLOWDOWN},i,t) \quad (43)$$

where:

LBLPRJ,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; $0 \leq f_{PRJ,BLOWDOWN,i,t} \leq 1$).

$$SNAGPRJ,OUT,i,t = SNAGPRJ,i,t \bullet f_{PRJ,SWDECAY,i,t} + SNAGPRJ,i,t \bullet f_{PRJ,SNAGFALLDOWN,i,t} \quad (44)$$

where:

$SNAGPRJ,i,t$ = 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; $0 \leq f_{PRJ,SWDECAY,i,t} \leq 1$).

$f_{PRJ,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, i , that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$).

The change in dead belowground wood (DBG) carbon stock in year, t ($t \text{ C yr}^{-1}$) is calculated as:

$$\Delta C_{PRJ,DBG,t} = S(DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t}) \bullet CF \quad (45a)$$

where:

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

$DBG_{PRJ,IN,i,t}$ = annual gain in dead belowground biomass for polygon i , year, t ($t \text{ d.m ha}^{-1} \text{ yr}^{-1}$).

$DBG_{PRJ,OUT,i,t}$ = annual loss in dead belowground biomass through decay, ($t \text{ d.m ha}^{-1} \text{ yr}^{-1}$) CF = carbon fraction of dry matter (IPCC default value = 0.5).

$$DBG_{PRJ,i,t+1} = DGB_{PRJ,i,t} + (DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t})$$

(45b)

where:

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

$DBG_{PRJ,IN,i,t}$ = annual gain in dead belowground biomass for polygon i , year, t ($t \text{ d.m ha}^{-1} \text{ yr}^{-1}$).

$DBG_{PRJ,OUT,i,t}$ = annual loss in dead belowground biomass through decay, ($t \text{ d.m ha}^{-1} \text{ yr}^{-1}$) CF = carbon fraction of dry matter (IPCC default value = 0.5).

$$DBG_{PRJ,IN,i,t} = [(APR_j \bullet LB_{PRJ,i,t} \bullet R_i) \bullet (f_{PRJ,NATURAL,i,t} + f_{PRJ,HARVEST,i,t} + f_{PRJ,DAMAGE,i,t})] \quad (45c)$$

where:

APR_j = area (ha) of forest land in polygon, i ;

$LB_{PRJ,i,t}$ = average live tree biomass ($t \text{ d.m. ha}^{-1}$) 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 APR_j , 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; $0 \leq f_{PRJ,NATURAL,i,t} \leq 1$), year, t (see equation 35),

$f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i , (unitless; $0 \leq f_{PRJ,HARVEST,i,t} \leq 1$), 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)

$$\text{DBGPRJ,OUT},i,t = \text{DBGPRJ},i,t \bullet \text{fPRJ,dgbDECAY},i,t \quad (45d)$$

where:

DBGPRJ,i,t = the total quantity of dead belowground in polygon i , year, t (equation 17b).

$\text{fPRJ,dgbDECAY},i,t$ = the annual proportional loss of dead belowground biomass due to decay, in polygon i , year, t (unitless; $0 \leq \text{fPRJ,dgbDECAY},i,t \leq 1$).

As in the baseline scenario the dead organic matter dynamics in Equations 38-45 including stand mortality, lying dead wood (CWD), snag creation and decay are dynamically modeled and tracked using FVS-FFE for each polygon, and output by carbon pool in the Stand Carbon Table by year. This includes additional modeling for these dead organic matter carbon pools in the harvest areas and fire areas using FVS fire simulations in this monitoring period. The harvest removals in the project scenario in this monitoring period were modeled and tracked by FVS-FFE for the polygons marked as harvested in the GIS spatial data for each year.

Harvested Wood Products

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

$$\Delta\text{CPRJ,HWP},t = \Delta\text{CPRJ,STORHWP},t - \Delta\text{CPRJ,EMITFOSSIL},t, \quad (46)$$

Where:

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

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

The annual change in carbon storage in harvested wood products in year t ($\Delta\text{CPRJ,STORHWP},t$; t C yr^{-1}) is calculated as:

$$\Delta\text{CPRJ,STORHWP},t = (\text{CPRJ,STORHWP},t2 - \text{CPRJ,STORHWP},t1) / T \quad (47)$$

where:

$\text{CPRJ,STORHWP},t2$ = carbon storage in harvested wood products at $t=2$; t C

$\text{CPRJ,STORHWP},t1$ = carbon storage in harvested wood products at $t=1$; t C

T = number of years between monitoring $t1$ and $t2$: 1,2,3... t years elapsed since the project start date

$$\text{CPRJ,TIMBER},h = S[(\text{LBLPRJ,FELLINGS},i,h - \text{LBLPRJ,FELLINGS},i,h \bullet \text{Ri} + \text{LBLPRJ,OTHER},i,h - \text{LBLPRJ,OTHER},i,h \bullet \text{Ri}) \bullet (1 - \text{fPRJ,BRANCH},i,h) \bullet (1 - \text{fPRJ,BUCKINGLOSS},i,h)] \bullet \text{CF} \quad (48)$$

where:

$\text{CPRJ,TIMBER},h$ = 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

$$C_{PRJ,MILL,h,k} = (C_{PRJ,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k}) \quad (49)$$

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

For each product type, k : the short-lived fraction ($P_{PRJ,SLF,k}$), medium-lived fraction ($P_{PRJ,MLF,k}$), and long-lived fraction ($P_{PRJ,LLF,k}$):

$$P_{PRJ,SLF,k} = 1 - P_{3\text{-year}} \quad (50a)$$

$$P_{PRJ,LLF,k} = P_{100\text{-year}} \quad (50b)$$

$$P_{PRJ,MLF,k} = P_{3\text{-year}} - P_{100\text{-year}} \quad (50c)$$

$$C_{PRJ,STORHWP,t} = S S ((C_{PRJ,MILL,h,k} \bullet P_{LLF,k}) + [(C_{PRJ,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20-h) / 20)]) \quad (51)$$

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)

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

$$\Delta C_{PRJ,EMITFOSSIL,t} = C_{PRJ,EMITHARVEST,t} + C_{PRJ,EMITMANUFACTURE,t} + C_{PRJ,EMITTRANSPORT,t} \quad (52)$$

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)

$$\Delta C_{PRJ,EMITHARVEST,t} = S[(LBLPRJ,FELLINGS,i,t - LBLPRJ,FELLINGS,i,t \bullet R_i + LBLPRJ,OTHER,i,t - LBLPRJ,OTHER,i,t \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet c_{HARVEST} \quad (53)$$

where:

$c_{HARVEST}$ = carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting; all other terms are as defined in equation 48.

$$C_{PRJ,EMITTRANSPORT,t} = S[(LBLPRJ,FELLINGS,i,t - LBLPRJ,FELLINGS,i,t \bullet R_i + LBLPRJ,OTHER,i,t - LBLPRJ,OTHER,i,t \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet S(f_{PRJ,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk}) \quad (54)$$

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 ; all other terms are as defined in equation 48.

$$C_{PRJ,EMITMANUFACTURE,t} = S[(LBLPRJ,FELLINGS,i,t - LBLPRJ,FELLINGS,i,t \bullet R_i + LBLPRJ,OTHER,i,t - LBLPRJ,OTHER,i,t \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet S(f_{PRJ,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF \quad (55)$$

Where:

$c_{MANUFACTUREk}$ = 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.

The HWP and Fossil Fuel Emissions calculations have been made for the project scenario in the same manner as the Baseline Scenario:

FVS-FFE models the transition of carbon removed from each polygon during harvest into the Harvested Products Report. FVS calculates and tracks harvested wood products pools following the VCS reference 1605b documentation required by VCS, including the modeling of HWP pool decay by product type, by year. Note that FVS-FFE outputs and tracks carbon storage and emissions in the landfill pool. Although VCS provides optional guidance to combine this pool with HWP, the pool amounts are minimal and the complexity to add these back to the HWP by product type is very high (and not possible within FVS-FFE itself). Therefore the landfill pool is excluded, which is consistent with the HWP tracking equations in VM0012 and the requirements of VCS.

Fossil fuel emissions from equipment and manufacturing calculations are made in the Darkwoods Carbon Model; worksheet: Summary Tables and Figures, using output data from the Harvested Wood Report in FVS-FFE, by year. Key assumptions used for the Darkwoods project in the Darkwoods Carbon Model spreadsheet follow the PD recommendations and are documented at the top of the calculation.

Market Leakage:

The outcome of the VCS Leakage Discount Factor determination = the value for MLF_y (56a)

To calculate the project market leakage (LE_y , t CO₂e yr⁻¹):

$$LE_y = MLF_y \cdot ER_{y,GROSS} \quad (56b)$$

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 CO₂e yr⁻¹). This term is calculated in equation 57.

The Market Leakage calculations are made from external references and the NFI website calculator; along with project data created in the Darkwoods Carbon Tool and an Excel Spreadsheet "**Lkp_PRJ_C_Pools_x_Year_Leakage**".

Final Emission Reduction, Deduction, and VCU Calculations:

Gross carbon emissions reductions ($ER_{y,gross}$; t CO₂e yr⁻¹) created by the carbon project are calculated annually as the difference between the baseline and project scenario net emission reductions/emissions:

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

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 CO₂e

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:

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

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 CO₂e yr⁻¹).

$ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios (t CO₂e yr⁻¹).

LE_y = Leakage in year y (t CO₂e yr⁻¹), as calculated in equation 56b.

The number of VCUs the project available for issuance and sale in year, y (VCU_y ; t CO₂e yr⁻¹), is calculated as:

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

where:

ER_y = the net GHG emissions reductions and/or removals in year (t CO₂e yr⁻¹), as calculated in equation 58.

$ER_{y,ERR}$ = the uncertainty factor for year, y , expressed as a proportion.

BR_y = estimated VCU-equivalent tCO₂e issued to the VCS Buffer Pool in year, y , calculated using the latest version of the VCS AFOLU Non-Permanence Risk Tool. BR_y 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

The summarizing calculations for Equations 57-59 are made within the Darkwoods Carbon Model spreadsheet, based on summarized annual emission reductions data by carbon pool that is output from the Darkwoods Carbon Database (summarized from FVS-FFE annual outputs by carbon pool).

The project-level uncertainty factor is calculated as follows:

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

where:

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

$$y_{d,h,i} = A_{PRJ,h} \cdot (y_{m,h,i} - y_{p,h,i}) \quad (60b)$$

where:

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)

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

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

1.654 the 90% confidence interval t -value

All other terms as defined in equation

60a.

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

where:

N = total number of plot observations in all analysis units or polygons

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

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

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.

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.

$$E_P = E_M + E_I \quad (60f)$$

The process and database files used to compile the carbon plot data for the Uncertainty Factor calculations is outlined in detail in the method. Summarized, the plot tree data were input into FVS-FFE by plot as stand data to generate aboveground standing live and dead tree biomass/carbon. The FVS Downed and Dead output was then replaced manually with the actual CWD transect data, following Pearson (2007). These plot carbon totals and comparable average AU modeled stand data are generated within a series of databases within the Darkwoods Carbon Database. These data are summarized and the calculations for equations 60a – 60f are undertaken in the spreadsheet “UF_BA_CLASS_Calcs_Bark_Adjusted_Feb19.xlsx”.

APPENDIX 3: VT0015 SUMMARY TABLES

Table 3.1 Summary of GHG emission reductions quantification

Year	Time Step (year)	$\Delta\text{CH}_4_{\text{bbt}}$ (t CO ₂ e)	$\Delta\text{N}_2\text{O}_{\text{fert}}$ (t CO ₂ e)	$\Delta\text{CO}_2_{\text{fft}}$ (t CO ₂ e)	$\Delta\text{CO}_2_{\text{HWPt}}$ (t CO ₂ e)	$\Delta\text{CH}_4_{\text{HWPt}}$ (t CO ₂ e)	$\Delta\text{CO}_2_{\text{ER,t}}$ (t CO ₂ e)	ER _t (t CO ₂ e)
2008	1	N/A	N/A	(12,165)	N/A	N/A	338,881	326,716
2009	2			(12,237)			338,881	326,644
2010	3			(13,105)			338,881	325,776
2011	4			(13,471)			284,835	271,363
2012	5			(13,376)			284,835	271,459
2013	6			(14,132)			261,134	247,001
2014	7			(14,116)			261,134	247,018
2015	8			(13,582)			261,134	247,551
2016	9			(14,161)			261,134	246,973
2017	10			(13,875)			34,015	20,140
2018	11			(14,098)			34,015	19,917
2019	12			(14,868)			34,015	19,147
2020	13			(14,358)			35,766	21,408
2021	14			(13,908)			35,766	21,858
2022	15			(16,681)			50,067	33,386
2023	16			(15,451)			50,067	34,616

Table 3.2 Summary of carbon stock change quantification

Year	Time step (year)	$\Delta\text{CO2}_{\text{PR,cml,t}}$ (t CO ₂ e)	$\Delta\text{CO2}_{\text{BL,cml,t}}$ (t CO ₂ e)	$\Delta\text{CO2}_{\text{ER,cml,t}}$ (t CO ₂ e)	$\Delta\text{CO2}_{\text{ER,cml,prior}}$ (t CO ₂ e)	$\Delta\text{CO2}_{\text{ER,vp}}$ (t CO ₂ e)	Years (years)
2008	1	3,253	(302,258)				
2009	2	54,867	(570,120)				
2010	3	34,569	(1,016,643)	1,016,643	1,016,643	1,016,643	3
2011	4	173,610	(1,299,879)				
2012	5	301,296	(1,586,313)	1,586,313	1,586,313	569,669	2
2013	6	431,685	(1,813,395)				
2014	7	551,578	(2,085,105)				
2015	8	602,419	(2,387,931)				
2016	9	760,131	(2,630,847)	2,630,847	2,630,847	1,044,535	4
2017	10	999,960	(2,638,898)				
2018	11	1,180,521	(2,674,853)				
2019	12	1,422,142	(2,732,892)	2,732,892	2,732,892	102,045	3
2020	13	1,879,686	(2,662,826)				
2021	14	1,973,367	(2,804,424)	2,804,424	2,804,424	71,532	2
2022	15	2,430,613	(2,733,478)				
2023	16	2,651,050	(2,904,557)	2,904,557	2,904,557	100,133	2

Table 3.3 Summary of carbon dioxide removals quantification

Year	Time step (year)	CR _{cml} (t CO ₂ e)	CR _{cml,prior} (t CO ₂ e)	CR _{vp} (t CO ₂ e)	CR _t (t CO ₂ e)
2008	1				11,523
2009	2				11,523
2010	3	34,569	34,569	34,569	11,523
2011	4				133,364
2012	5	301,296	301,296	266,727	133,364
2013	6				114,709
2014	7				114,709
2015	8				114,709
2016	9	760,131	760,131	458,835	114,709
2017	10				220,670
2018	11				220,670
2019	12	1,422,142	1,422,142	662,011	220,670
2020	13				275,613
2021	14	1,973,367	1,973,367	551,225	275,613
2022	15				338,842
2023	16	2,651,050	2,651,050	677,683	338,842

Table 3.4 Summary of VCU quantification

Year	Time step (year)	VCU _t (t CO ₂ e)	VCU _{ER,t} (t CO ₂ e)	VCU _{CR,t} (t CO ₂ e)
2008	1	244,007	235,694	8,313
2009	2	256,207	247,477	8,730
2010	3	348,802	336,886	11,916
2011	4	345,246	231,482	113,764
2012	5	338,237	226,809	111,428
2013	6	286,793	195,843	90,950
2014	7	317,035	216,499	100,536
2015	8	284,577	194,466	90,111
2016	9	376,211	256,894	119,317
2017	10	181,419	15,173	166,246
2018	11	160,024	13,247	146,777
2019	12	217,816	17,390	200,426
2020	13	277,899	20,030	257,869
2021	14	172,832	12,700	160,132
2022	15	261,521	23,456	238,065
2023	16	263,941	24,465	239,476