

The Nature Conservancy Of Canada

Darkwoods Forest Carbon Project

V. 1.6

Document Prepared By 3GreenTree Ecosystem Services Ltd.

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1 PROJECT DETAILS

1.1 Summary Description of Project

The Nature Conservancy of Canada (NCC) acquired the fee simple 54,792 ha (135,394 acre) Darkwoods Property near Creston, BC in April of 2008, with the objective of managing the land for ecological conservation objectives. NCC has undertaken a 100 year VCS IFM-LtPF forest carbon project with a start date of the acquisition date to provide carbon finance to complete acquisition financing and funding for ongoing property management, conservation project activities, and ownership costs.

The Darkwoods Forest Carbon Project achieves net GHG emission reductions and removals through the avoidance of emissions due to logging in the baseline scenario.

Under the baseline scenario, a 100-year uneven harvest schedule is implemented with the typical regional practice of clearcut logging with minimum legal requirements for private forestlands in B.C. and comparable regional practices.

The project scenario is conservation management activities, wherein NCC undertakes the carbon project and ecosystem protection and enhancement activities. The project scenario anticipates a low level of timber removal as part of conservation management activities for long-term ecosystem/habitat enhancement and risk management.

1.2 Sectoral Scope and Project Type

Sector 14 - AFOLU

Improved Forest Management (IFM),

Logged Forest to Protected Forest (LtPF).

The Darkwoods Property is consistent with the VCS eligibility for an IFM-LtPF project by “protecting unlogged forests that would be logged in the absence of carbon finance”.

1.3 Project Proponent

Organization	Role	Contact/Address
Nature Conservancy of Canada	Project Proponent	Tom Swann 825 Broughton Street, Suite 200 Victoria, BC, Canada V8W 1E5 Tel: +1 250-479-3191

1.4 Other Entities Involved in the Project

Organization	Role	Contact/Address
3GreenTree Ecosystem Services Ltd.	Project Developer	Mike Vitt 3960 Marine Ave. Belcarra, BC, Canada V3H 4R9 Tel: +1 778-998-5478

1.5 Project Start Date

The Darkwoods carbon project and the crediting period start dates are the date of closing on the acquisition. The GHG emission reductions began the day of acquisition, when competing bidder's development plans were avoided by NCC's acquisition.

Project Start Date: April 1, 2008 - The project start date is the date of acquisition, and is the same as the crediting period start date.

1.6 Project Crediting Period

Crediting Period Start Date: April 1, 2008 - The GHG emission reductions began at the acquisition, when avoided logging began due to NCC's ownership.

Crediting Period: 100 years - NCC intends to own and manage the Darkwoods property in perpetuity, and has selected the maximum carbon project length.

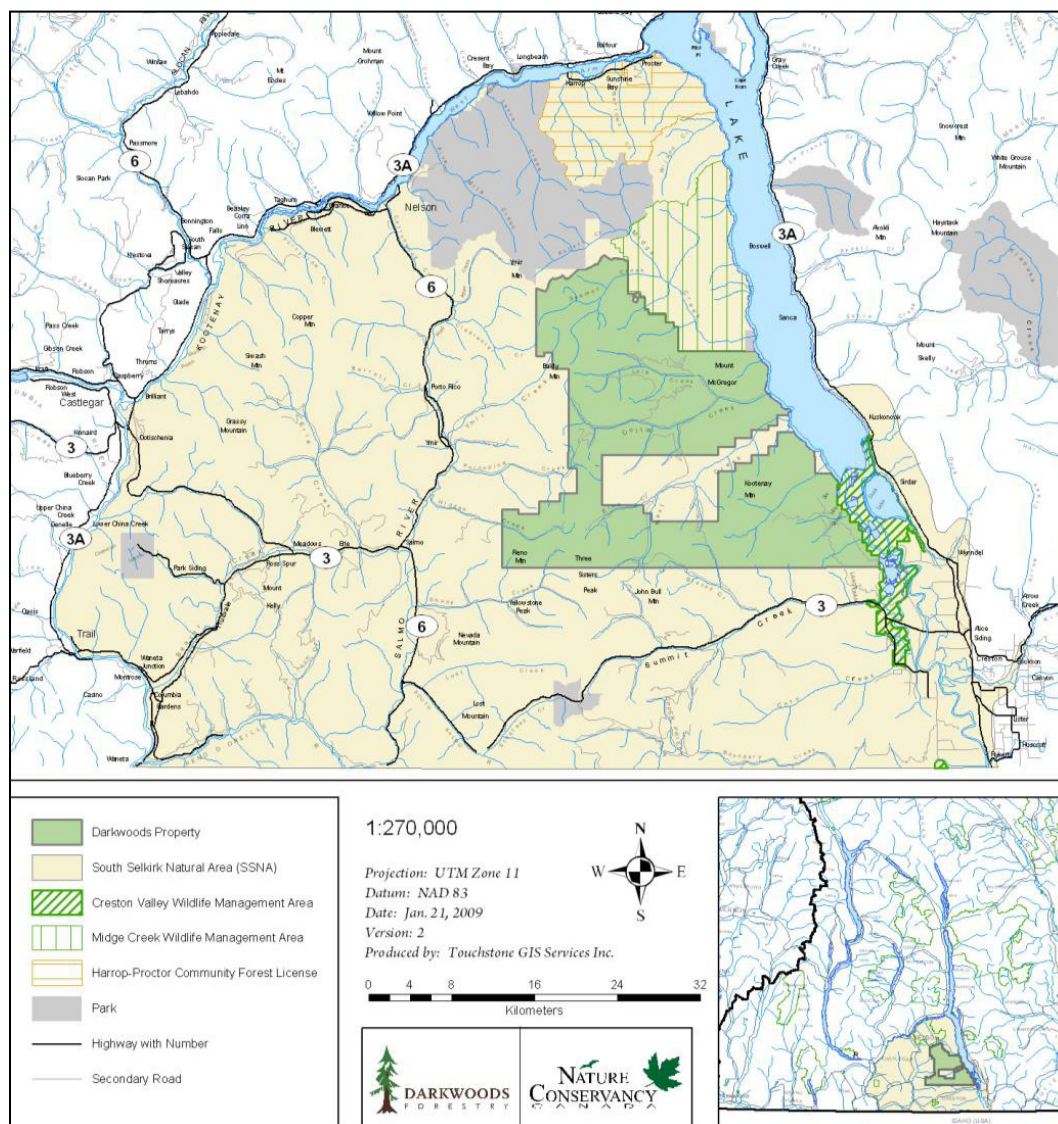
1.7 Project Location

The Darkwoods property is a 54,792 ha (135,394 acre) contiguous parcel of fee simple private property in south eastern British Columbia just north east of the municipality of Creston. The Darkwoods property is bounded by Kootenay Lake on the east and various crown and private land on the other property boundaries. There is a significant in-holding in the center of the property that is owned and managed by the Windall Box Company, with access rights through the Darkwoods property. 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 Overview Map



1.8 Title and Reference of Methodology

1.9 Methodology: VM0012 - Improved Forest Management in Temperate and Boreal Forests (LtPF), v1.0

Project Description: Darkwoods Forest Carbon Project – Version 1.8. Validated April 21, 2011.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

This monitoring period represents years 4 and 5 of the ongoing project and includes the calendar years 2011 and 2012. During this monitoring period, NCC has undertaken low-level timber

harvesting in the project scenario as planned. The harvesting has followed NCC's project plan to ramp the previous owners harvest level down over the initial 3-5 year period to reduce the impact on local communities, and to focus on salvaging Mountain Pine Beetle (MPB) attacked pine stand types. The monitoring period harvest levels are consistent with the project scenario plan in the PDD.

During this period NCC invested in a new forest inventory dataset for the Darkwoods property based on new aerial photography obtained in July 2011 (see Section 5.1 and 4). In addition to the new inventory, 51 new plots were established on the property to bring the total plots up to 67 (see Sections 2.2 and 3.3). All of the calculations and spatial information utilized in the both the project and baseline scenarios for the 2011-2012 monitoring period are based upon the new inventory.

As per the PDD, the project does not undertake specific market leakage monitoring; instead updates the standardized market calculations following the methodology and PDD, as shown in Table 16 and the Darkwoods Carbon Model (see Table 18 for reference). Activity shifting monitoring is described in Section 3.3.

Also as per the PDD, the project does not undertake specific monitoring activities related to non-permanence factors, other than as part of property monitoring for natural and man-made activities as outlined in Section 3.3. The non-permanence risk tool is updated at each verification as per the VCS Standard requirements, and has been submitted as a separate file as part of this verification process (see file references, Table 18).

The project has undertaken all required monitoring activities on an annual basis during the monitoring period as outlined in Section 3.3.

2.2 Project Description Deviations

There is one minor deviation from the methodology and related monitoring plan elements described in the PDD. The plot network while expanded considerably from that in place during the first monitoring period still does not meet the stated criteria of having a minimum of one plot within each analysis unit. The reason for this discrepancy is that the 51 new plots that were established were located based upon the old inventory. Differences in the location of analysis units in the new inventory resulted in 3 of the smaller analysis units (out of 20 total analysis units covering the entire property) being left without representation (AU 110, AU 201, and AU 406b). The combined area of these analysis units represents <3% of the total productive forest area. These three analysis units could have been incorporated into one or more of the other larger analysis units; however, the decision was made to keep the analysis units as the separation of the inventory polygons into more specifically defined forest units improves the accuracy of the modeling and the associated carbon calculations. Table 2 shows the breakdown of productive and non-productive forest area by analysis unit as well as the actual and expected number of plots in each. Plots will be established within these un-represented analysis units as a priority within the ongoing plot establishment program on Darkwoods, and are expected to be completed prior to the next monitoring period.

Table 2. Summary of the area of productive and non-productive forest by analysis unit.

C_AU	Productive Forest (ha)	Non-productive Forest (ha)	Actual plots	Expected plots ¹
101	3,431.3	286.9	3	5.6
102	1,635.3	145.1	7	2.7
103	11,273.8	1,381.8	13	18.5
104	3,444.0	240.1	5	5.6
105	1,245.1	118.5	1	2.0
106	1,268.3	26.6	4	2.1
107	2,943.0	212.4	8	4.8
108	1,708.8	55.4	1	2.8
109	1,634.4	108.4	2	2.7
110	38.4	0.9	0	0.1
111		8,563.5	8	0.0
201	734.5	17.9	0	1.2
202	440.1	16.2	1	0.7
203	1,896.7	187.4	1	3.1
204	4,083.9	199.0	6	6.7
206	1,443.1	175.5	2	2.4
207	305.5	15.0	1	0.5
209	2,243.0	123.2	2	3.7
406a	166.8	28.0	1	0.3
406b	376.3	198.8	0	0.6
Totals	40,312	12,101	66	66

¹. 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. Two of the plots in C_AU 102 were averaged together and counted as one as they were located in the same inventory polygon.

2.3 Grouped Project

Not applicable

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data and parameters available at validation are provided in Table 3)

Table 3. Data and parameters available at validation.

Data/parameter	THLB
Data unit	Ha
Description:	Timber harvesting landbase area

Source of data	GIS
Value Applied	See GIS databases (referenced in Section 5.2)
Justification of choice of data or description of measurement methods and procedures applied:	Required for baseline and project calculations
Comments:	

Data/parameter	$A_{BSL,i}$, $A_{PRJ,i}$
Data unit	Ha
Description:	Respective areas of baseline and project polygon, <i>i</i>
Source of data	Latest NCC Darkwoods GIS spatial inventory data (see Section 5.2).
Value Applied	See GIS databases (referenced in Section 5.2)
Justification of choice of data or description of measurement methods and procedures applied:	Data are inputted into FPS-ATLAS
Comments:	First used in equations 4 and 32 of the Project Design Document, for the baseline and project cases, respectively

Data/parameter	CF
Data unit	$t\ C\ t^{-1}\ d.m.$
Description:	Carbon fraction of dry matter
Source of data	IPCC 2006
Value Applied	0.5
Justification of choice of data or description of measurement methods and procedures applied:	IPCC default value
Comments:	First used in equations 4 and 32 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	R_i
Data unit	unitless
Description:	Root:shoot ratio in polygon, i
Source of data	Based on Li et al. 2003 but modified according to tree age according to Lehtonen et al. 2004
Value Applied	Variable – calculated as a function of age and species based on the references. Conifers range in value from 0.19 to 0.25 depending age. Hardwoods range in value for 0.18 to 0.24. See root biomass worksheet in the Douglas fir example (Appendix 5 of the Project Design Document).
Justification of choice of data or description of measurement methods and procedures applied:	Root biomass is difficult to measure directly.
Comments:	First used in equations 5b and 33b of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 \leq f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t} \leq 1$)
Description:	The proportion of biomass that dies from natural mortality in polygon, i , year, t , in the baseline and project cases, respectively.
Source of data	Expert opinion
Value Applied	0.2 % per annum
Justification of choice of data or description of measurement methods and procedures applied:	Estimate established over years of FORECAST development comparing model outputs of coarse woody debris and snag accumulation against field data.
Comments:	First used in equations 7 and 35 of the Project Design Document for the baseline and project cases, respectively.

Data/parameter	$f_{BSL,HARVEST,i,t}$, $f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 \leq f_{BSL,HARVEST,i,t}$, $f_{PRJ,HARVEST,i,t} \leq 1$)

Description:	The proportion of biomass removed by harvesting from polygon, i , in year, t , in the baseline and project cases, respectively.
Source of data	Annual arvest schedule produced from FPS ATLAS, by statum (inventory polygon).
Value Applied	Variable – see Tables 14 and 15 for summarized total annual harvest volume and area. Summarized from individual inventory data produced with FPS Atlas.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 8 and 36 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,DAMAGE,i,t}$, $f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 \leq f_{BSL,DAMAGE,i,t}$, $f_{PRJ,DAMAGE,i,t} \leq 1$)
Description:	The proportion of additional biomass removed by for road and landing construction in polygon, i , year, t , in the baseline and project cases, respectively.
Source of data	Expert opinion initially as a conservative measure. Monitoring data on an ex-post basis.
Value Applied	Zero in ex-ante baseline and project scenarios. From monitoring data for project ex-post calculations.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 9 and 37 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,BLOWDOWN,i,t}$, $f_{PRJ,BLOWDOWN,i,t}$
Data unit	unitless ($0 \leq f_{BSL,BLOWDOWN,i,t}$, $f_{PRJ,BLOWDOWN,i,t} \leq 1$)
Description:	The proportion of live aboveground tree biomass subject to blowdown in polygon, i , year, t , in the baseline and project cases, respectively.

Source of data	Included within the natural mortality factor calculated in $f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$ Also captured by spatial monitoring if >4ha, which would be incorporated as a new polygon on an ex-post.
Value Applied	Zero for the baseline and project ex-ante calculations (part of the natural mortality factor source data).
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 12 and 40 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,BRANCH,i,t}$, $f_{PRJ,BRANCH,i,t}$
Data unit	unitless ($0 \leq f_{BSL,BRANCH,i,t}$, $f_{PRJ,BRANCH,i,t} \leq 1$)
Description:	The proportion of aboveground tree biomass comprised of branches ≥ 5 cm diameter in polygon, i , year, t , in the baseline and project cases, respectively.
Source of data	Calculated within FORECAST using calibration data from allometric biomass equations by species based upon (Standish, Manning, & Demaerschalk, 1985).
Value Applied	Variable, see source of data.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 12 and 40 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,BUCKINGLOSS,i,t}$, $f_{PRJ,BUCKINGLOSS,i,t}$
Data unit	unitless ($0 \leq f_{BSL,BUCKINGLOSS,i,t}$, $f_{PRJ,BUCKINGLOSS,i,t} \leq 1$)
Description:	The proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i , year, t , in the baseline and project cases, respectively.
Source of data	Based on (Smith, Miles, Vissage, & Pugh, 2004), and expert opinion based on FORECAST modeler previous

	experience.
Value Applied	0.10 of stemwood and bark is assumed to be left on site.
Justification and choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 12 and 40 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,SNAGFALLDOWN,i,t}$, $f_{PRJ,SNAGFALLDOWN,i,t}$
Data unit	unitless ($0 \leq f_{BSL,SNAGFALLDOWN,i,t}$, $f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$)
Description:	The proportion of snag biomass in polygon, i , year, t , that falls over, in the baseline and project cases, respectively.
Source of data	From: (Parish, Antos, Ott, & Di Lucca, 2010)
Value Applied	Variable, depending on species and dbh. Modeled by species and dbh class within FORECAST.
Justification of choice of data or description of measurement methods and procedures applied:	Fall rates derived from accelerated failure rate model described in Parish et al. 2009.
Comments:	First used in equations 12 and 40 of the Project Design Document for the baseline and project cases, respectively.

Data/parameter	$f_{BSL,lwDECAY,i,t}$, $f_{PRJ,lwDECAY,i,t}$
Data unit	unitless ($0 \leq f_{BSL,lwDECAY,i,t}$, $f_{PRJ,lwDECAY,i,t} \leq 1$)
Description:	The annual proportional loss of lying dead biomass due to decay, in polygon i , year, t (unitless; $0 \leq f_{PRJ,lwDECAY,i,t} \leq 1$), in the baseline and project cases, respectively.
Source of data	Based upon: (Harmon, et al., 1986), (Laiho & and Prescott, 2004).
Value Applied	Variable, modeled within FORECAST, based upon a an exponential decay function similar to: Mass loss occurs in proportion to the amount of mass remaining in accordance with an a single exponential

	model, of the general form: $Y_t = Y_o e^{-kt}$ where Y_o is the initial quantity of material, Y_t the amount left at time t, and k is a decay constant. k-values for the species present on the Darkwoods project area are derived from references provided above.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 13 and 41 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,SWDECAY,i,t}$, $f_{PRJ,SWDECAY,i,t}$
Data unit	unitless ($0 \leq f_{BSL,SWDECAY,i,t}$, $f_{PRJ,SWDECAY,i,t} \leq 1$)
Description:	The proportional loss of snag biomass due to decay, in polygon i , year t , in the baseline and project cases, respectively.
Source of data	Based upon: (Vanderwel, Caspersen, & Woods, 2006a); (Vanderwel, Malcolm, & Smith, 2006b); (Kurz & et al, 2009)
Value Applied	Modeled within FORECAST by species based on calibration from the source data references above.
Justification of choice of data or description of measurement methods and procedures applied:	As with lying dead wood (see $f_{BSL,LWDECAY,i,t}$), $f_{BSL,SWDECAY,i,t}$ is assumed to occur in proportion to the amount of mass remaining in accordance with a first order exponential model
Comments:	First used in equations 13 and 41 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,dgbDECAY,i,t}$, $f_{PRJ,dgbDECAY,i,t}$
Data unit	unitless ($0 \leq f_{BSL,dgbDECAY,i,t}$, $f_{PRJ,dgbDECAY,i,t} \leq 1$)
Description:	The proportional loss of dead belowground biomass due to decay, in polygon i , year t , in the baseline and project cases, respectively.

Source of data	Based upon: (Moore, Trofymow, Siltanen, Prescott, & CIDET, 2005); (Melin, Petersson, & Nordfjell, 2009)
Value Applied	Modeled within FORECAST by species based on calibration from the source data references above.
Justification of choice of data or description of measurement methods and procedures applied:	As with lying dead wood (see $f_{BSL,LWDECAY,i,t}$, $f_{BSL,SWDECAY,i,t}$ is assumed to occur in proportion to the amount of mass remaining in accordance with a first order exponential model
Comments:	First used in equations 17d and 45d of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,PRODUCTk}$, $f_{BSL,PROCESSk}$, $f_{PRJ,PRODUCTk}$, and $f_{PRJ,PROCESSk}$
Data unit	unitless; $0 \leq f_{BSL,PRODUCTk}$, $f_{BSL,PROCESSk}$, $f_{PRJ,PRODUCTk}$, and $f_{PRJ,PROCESSk} < 1$
Description:	The respective fractions of harvested biomass allocated to a given forest product type, k , and its associated processing efficiency for the baseline (BSL) and project (PRJ) cases.
Source of data	(Thrower & Orr-Ewing, 2004), (Miner, 2006).
Value Applied	See Appendix 2, Table 1 of the Project Design Document or Darkwoods Carbon Model 2011-2012 v.1.1.xlsx spreadsheet.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 20 and 48 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,PERMHWPk}$, $f_{PRJ,PERMHWPk}$
Data unit	unitless ($0 \leq f_{BSL,PERMHWPk}$, $f_{PRJ,PERMHWPk} \leq 1$)
Description:	The fraction of biomass allocated to permanent storage, for each product type, k , in the baseline and project cases, respectively.
Source of data	Permanent carbon storage was calculated here using

	the 100-year method developed by (Miner, 2006).
Value Applied	Values are product-specific, as derived below.
Justification of choice of data or description of measurement methods and procedures applied:	$f_{BSL,PERMHWPK} = (1/(1 + (\ln(2)/HL_k)))^Y$ where: HL_k is the half-life of a given product type, <i>k</i> (years), and <i>Y</i> is the elapsed time (i.e, 100 years). See Appendix 2, Table 1 for HL_k values.
Comments:	First used in equations 19 and 47 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,BARK}$, $f_{BSL,COARSE}$, and $f_{BSL,FINE}$ $f_{PRJ,BARK}$, $f_{PRJ,COARSE}$, and $f_{PRJ,FINE}$
Data unit	unitless; $0 \leq f_{BSL,BARK}$, $f_{BSL,COARSE}$, $f_{BSL,FINE}$, $f_{PRJ,BARK}$, $f_{PRJ,COARSE}$, and $f_{PRJ,FINE} < 1$
Description:	The proportions of bark, coarse, and fine residual biomass, respectively, (unitless; $0 \leq f_{BSL,BARK}$, $f_{BSL,COARSE}$, $f_{BSL,FINE}$, < 1) that comprise $B_{BSL,RESIDUAL,t}$ and $B_{PRJ,RESIDUAL,t}$ for the baseline (BSL) and project (PRJ) cases.
Source of data	(Perlack, Wright, Turhollow, Graham, Stodkes, & Erback, 2005)
Value Applied	26.5%, for $f_{BSL,BARK}$ and $f_{PRJ,BARK}$ 42.9%, for $f_{BSL,COARSE}$ and $f_{PRJ,COARSE}$ 30.7%, for $f_{BSL,FINE}$ and $f_{PRJ,FINE}$
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	First used in equations 23a-c and 51a-c of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,BARKUSE}$, $f_{BSL,COARSEUSE}$, and $f_{BSL,FINEUSE}$ $f_{PRJ,BARKUSE}$, $f_{PRJ,COARSEUSE}$, and $f_{PRJ,FINEUSE}$
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Data unit	unitless; $0 \leq f_{BSL,BARKUSE}, f_{COARSEUSE}, f_{FINEUSE} < 1$
Description:	The proportions of bark, coarse, and fine residual biomass, respectively, allocated to secondary manufacturing, for the baseline (BSL) and project (PRJ) cases.
Source of data	(Perlack, Wright, Turhollow, Graham, Stodkes, & Erback, 2005)
Value Applied	100%, for $f_{BSL,BARKUSE}$ and $f_{PRJ,BARKUSE}$ 85%, for $f_{BSL,COARSEUSE}$ and $f_{PRJ,COARSEUSE}$ 42%, for $f_{BSL,FINEUSE}$ and $f_{PRJ,FINEUSE}$
Justification of choice of data or description of measurement methods and procedures applied:	Evidence indicates that on average 80% of bark is combusted for energy, with the remainder used principally as mulch (Perlack et al. 2005). Decay rates for mulch are difficult to estimate. Hence, as a default, all bark ($f_{BSL,BARKUSE}$) is assumed to be 100% combusted, a conservative assumption.
Comments:	First used in equations 23a-c and 51a-c of the Project Design Document for the baseline and project cases, respectively

Data/parameter	$f_{BSL,PROCESSc}$ and $f_{BSL,PROCESSf}$ $f_{PRJ,PROCESSc}$ and $f_{PRJ,PROCESSf}$
Data unit	unitless; $0 \leq f_{PRJ,PROCESSc}, f_{PRJ,PROCESSf} < 1$
Description:	Processing efficiencies of coarse and fine residuals, respectively, in secondary manufacturing, for the baseline (BSL) and project (PRJ) cases.
Source of data	(Perlack, Wright, Turhollow, Graham, Stodkes, & Erback, 2005)
Value Applied	85 % to all processing efficiencies
Justification of choice of data or description of measurement methods and procedures applied:	Processing efficiencies of coarse and fine residuals in secondary manufacturing are typically much higher than primary manufacturing.
Comments:	First used in equations 24 and 52 of the Project Design Document for the baseline and project cases, respectively

Data/parameter	BEF
Data unit	unitless
Description:	Biomass expansion factors
Source of data	Not applicable
Value Applied	No specific BEF are used other than the root:shoot variable described above.
Justification of choice of data or description of measurement methods and procedures applied:	
Comments:	

Data/parameter	Allometric equation parameters
Data unit	Unitless
Description:	Convert height and DBH into biomass of component pools.
Source of data	Allometric equations from (Standish, Manning, & Demaerschalk, 1985) are used to calibrate biomass modeling within FORECAST. See Section 3.
Value Applied	Variable by species, see source of data.
Justification of choice of data or description of measurement methods and procedures applied:	Used to derive biomass estimates for pools that are difficult to measure.
Comments:	Are used in conjunction with permanent sample plot data to estimate biomass.

3.2 Data and Parameters Monitored

Data and parameters to be monitored are provided in Table 4. All required parameters have been monitored. The source of data for all parameters is described in Table 4, and the analysis of this data is described throughout this report. Key standard operating procedures, data files, calculations, and model outputs are listed in Table 18.

Table 4. Data and parameters to be monitored.

Data/parameter	$A_{PRJ,i}$
Data unit	Ha
Description:	Area of forest land in polygon, <i>i</i>
Source of data	Latest NCC Darkwoods GIS spatial inventory data (see Section 5.2).
Description of measurement methods and procedures to be applied:	GIS inventory data updated from GPS coordinates and Remote Sensing data.
Frequency of monitoring/recording:	Annual
Value Applied	
Monitoring equipment:	Visual, satellite, orthophotos
QA/QC procedures to be applied:	Standard GIS QA/QC procedures. Latest NCC Standard Operating Procedures (SOP)
Calculation method:	
Comments:	First used in equations 4 and 32 of the Project Design Document, for the baseline and project cases, respectively.

Data/parameter	$A_{PSP,i}$
Data unit	m ²
Description:	Area of permanent sample plot in polygon, <i>i</i>
Source of data	Field measurement
Description of measurement methods and procedures to be applied:	Standard plot layout design
Frequency of monitoring/recording:	Plot measurements are repeated on 5-year intervals
Value Applied	TBD – Fixed area
Monitoring equipment:	GPS, measuring tape
QA/QC procedures to be applied:	GPS of plot center. Latest NCC Standard Operating Procedures (SOP) followed, including check cruising

	processes.
Calculation method:	GPS positioning of plot centre. Tape measurements to calculate area. Potential use of prisms to derive plots size.
Comments:	

Data/parameter	DBH_{i,t}
Data unit	Cm
Description:	Diameter at breast height measured for each tree in the sample plots at time, <i>t</i>
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 Applied	As measured
Monitoring equipment:	DBH tape, data logger
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Measured
Comments:	Used in allometric biomass equations

Data/parameter	Height_{i,t}
Data unit	M
Description:	Tree height measured for each tree in the sample plots at time, <i>t</i>
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied:	All trees > 1.3 m tall within a permanent sample plot
Frequency of monitoring/recording:	Individual tree measurements are repeated on 5-year intervals

Value Applied	As measured
Monitoring equipment:	Hypsometer, a transit, a clinometer, a relascope, a laser or other instrument designed for the measuring height.
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Measured
Comments:	Used in allometric biomass equations.

Data/parameter	B_{AGi,t}
Data unit	t d.m. ha ⁻¹
Description:	Aboveground live tree biomass in polygon, <i>i</i> , year, <i>t</i> , in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures to be applied:	Calculated from Height _{i,t} , DBH _{i,t} , and A _{p,i,t}
Frequency of monitoring/recording:	Upon establishment of PSP. Every 5 years, thereafter.
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Above ground biomass for each tree within a permanent sample plot will be estimated from allometric equations using height and dbh (Standish, Manning, & Demaerschalk, 1985). Area-based estimates of biomass will then be derived.
Comments:	Data will be used to validate ex-ante values from inventory + model output

Data/parameter	B_{BGi,t}
Data unit	t d.m. ha ⁻¹
Description:	Belowground live tree biomass in polygon, <i>i</i> , year, <i>t</i> , 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 $B_{AGi,t}$ and R_i
Frequency of monitoring/recording:	Upon establishment of PSP. Every 5 years, thereafter.
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Equation 28d of the Project Design Document
Comments:	Data will be used to validate ex-ante values from inventory + model output

Data/parameter	$B_{TOTALi,t}$
Data unit	t d.m. ha ⁻¹
Description:	Total live tree biomass in polygon, i , year, t , in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures to be applied:	Calculated from $B_{AGi,t}$ and $B_{BGI,t}$
Frequency of monitoring/recording:	Upon establishment of PSP. Every 5 years, thereafter.
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Equation 28b of the Project Design Document
Comments:	Data will be used to validate ex-ante values from inventory + model output

Data/parameter	$C_{LB,i,t}$
Data unit	t C ha ⁻¹

Description:	Total carbon storage in live tree biomass in polygon, i , year, t , in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures to be applied:	Calculated from $B_{AGi,t}$ and $B_{BGi,t}$ and CF
Frequency of monitoring/recording:	Upon establishment of PSP. Every 5 years, thereafter.
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Equation 28c of the Project Design Document
Comments:	Data will be used to validate ex-ante values from inventory + model output

Data/parameter	$C_{DOM,i,t}$
Data unit	$t\ C\ ha^{-1}$
Description:	Total carbon storage in dead organic matter in polygon, i , year, t , in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures to be applied:	Calculated from $DOM_{SNAGi,t}$ and $DOM_{LDWi,t}$ and CF
Frequency of monitoring/recording:	Upon establishment of PSP. Every 5 years, thereafter.
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Equation 28e of the Project Design Document
Comments:	Data will be used to validate ex-ante values from inventory + model output

Data/parameter	Mean tree age
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Data unit	years
Description:	Mean tree age with a given permanent sampling plot in polygon, <i>i</i> , for the project case.
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied:	Age will be recorded from a sample of dominant trees within a PSP
Frequency of monitoring/recording:	Upon establishment of permanent a sample plot.
Value Applied	Variable
Monitoring equipment:	Tree coring bit.
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Cores will be analyzed by counting rings following NCC SOP's.
Comments:	Data will be used to validate and update inventory (see Section 3)

Data/parameter	$f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 \leq f_{PRJ,NATURAL,i,t} \leq 1$)
Description:	The proportion of biomass that dies from natural mortality in polygon, <i>i</i> , year, <i>t</i> , in the project case.
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied:	Height and dbh of dead trees in permanent sample plots will be recorded.
Frequency of monitoring/recording:	Every 5 years
Value Applied	Proportion
Monitoring equipment:	Observation
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Tree mass components calculated from allometric equations (Standish, Manning, & Demaerschalk, 1985) and biomass expansion factors (Li, Kurz, Apps, & Beukema, 2003); (Lehtonen et al. 2004). Mass is converted to its carbon equivalent by multiplying by the carbon fraction (0.5). Proportion derived by comparison

	with calculated estimates of total carbon in polygon, i .
Comments:	First used in equations 7 and 35 of the Project Design Document for the baseline and project cases, respectively.

Data/parameter	$f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 \leq f_{PRJ,HARVEST,i,t} \leq 1$)
Description:	The proportion of biomass removed by harvesting from polygon, i , in year, t , in the project case.
Source of data	Darkwoods harvesting records
Description of measurement methods and procedures to be applied:	Volume derived from harvesting records. Wood density (see below) used to derive biomass estimates. Modeled estimates of total biomass in polygon, i, used to derive parameter.
Frequency of monitoring/recording:	Every 5 years
Value Applied	Proportion
Monitoring equipment:	
QA/QC procedures to be applied:	Data will be verified by ground-truthing and comparison with remote sensing information.
Calculation method:	Harvested volume is converted to mass by multiplying by average wood density (0.4; Gonzalez 1990). Proportion derived by comparison with modeled estimates of total biomass in polygon, i .
Comments:	The average wood density value of 0.4 kg m^{-3} meets the criteria for default parameters specified by VCS as it comes from a peer-reviewed source (Gonzalez 1990 ¹) with specific data for British Columbia. The following are green wood density values (kg m^{-3}) taken from Gonzalez for the dominant tree species in the Darkwoods landbase: Douglas-fir- 0.42,0.437; Western red cedar- 0.329, 0.342; Subalpine fir 0.331,0.329;Western

¹ Gonzalez, J.S. 1990. Wood density of Canadian tree species. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-315.

	hemlock-0.410, 0.423; Lodgepole pine 0.403, 0.427; Engelmann spruce 0.385, 0.405. The 0.4 value represents an average value. First used in equations 8 and 36 of the Project Design Document for the baseline and project cases, respectively.
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Data/parameter	$f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 \leq f_{PRJ,DAMAGE,i,t} \leq 1$)
Description:	The proportion of additional biomass removed by 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:	Areal estimate of removals derived from remote sensing data.
Frequency of monitoring/recording:	Annual.
Value Applied	Proportion
Monitoring equipment:	
QA/QC procedures to be applied:	Data will be verified by ground-truthing or remote sensing information.
Calculation method:	Areal estimate of removals is multiplied by average carbon density within a polygon.
Comments:	First used in equations 9 and 37 of the Project Design Document for the baseline and project cases, respectively.

Data/parameter	$DOM_{SNAG,i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description:	Total mass of dead organic matter contained in standing dead wood in polygon, i , year, t in the project case.
Source of data	Permanent sample plots
Description of measurement methods and procedures	Calculated from Height _{i,t} , DBH _{i,t} , and A _{p,i,t} of dead trees

to be applied:	measured in permanent sample plots described in Section 3 of the Project Design Document
Frequency of monitoring/recording:	Every 5 years
Value Applied	Variable
Monitoring equipment:	Observation
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Standing biomass for all snags within a permanent sample plot will be estimated from allometric equations using height and dbh (Standish, Manning, & Demaerschalk, 1985).
Comments:	

Data/parameter	DOM_{LDW,i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description:	Total mass of dead organic matter contained in lying dead wood in polygon, <i>i</i> , year, <i>t</i> in the project case.
Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied:	Calculated from the line intersect method described in Section 3
Frequency of monitoring/recording:	Every 5 years
Value Applied	Variable
Monitoring equipment:	Observation
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Calculated using the following field-measured parameters $L_{i,t}$, $d_{n,i,t}$, $D_{LDW,c,i,t}$, and $N_{i,t}$
Comments:	

Data/parameter	V_{LDW,c}
Data unit	m ⁻³ ha ⁻¹
Description:	Total volume of dead organic matter contained in lying dead wood in polygon, <i>i</i> , year, <i>t</i> in the project case.

Source of data	Permanent sample plots
Description of measurement methods and procedures to be applied:	Calculated from the line transect method described in Section 3.3 of the Project Design Document
Frequency of monitoring/recording:	Every 5 years
Value Applied	Variable
Monitoring equipment:	Observation
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Calculated using the following field-measured parameters $L_{i,t}$, $D_{LDW,c,i,t}$, and $N_{i,t}$
Comments:	

Data/parameter	$L_{i,t}$
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	Tape
Description of measurement methods and procedures to be applied:	Field measurements
Frequency of monitoring/recording:	Plot measurements are repeated on 5-year intervals
Value Applied	Default 100m
Monitoring equipment:	Tape
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	
Comments:	

Data/parameter	$d_{n,i,t}$
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	Field measurement
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:	Plot measurements are repeated on 5-year intervals
Value Applied	As measured
Monitoring equipment:	Caliper, diameter tape
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	
Comments:	Used to calculate mass of lying dead wood DOM_{LDW}

Data/parameter	$N_{i,t}$
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:	Plot measurements are repeated on 5-year intervals
Value Applied	As measured
Monitoring equipment:	Visual observation
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	
Comments:	Used to calculate mass of lying dead wood DOM_{LDW}

Data/parameter	$D_{LDW,c,i,t}$
Data unit	t d.m. m ³
Description:	Basic wood density of dead wood in the density class, <i>c</i> along the transect in polygon, <i>i</i> , at time, <i>t</i> .
Source of data	Two 50-m lines are established bisecting each plot and wood pieces > 10 cm diameter intersecting transect are sampled.
Description of measurement methods and procedures to be applied:	Pieces of known volume are taken to lab, dried and weighed to calculate density
Frequency of monitoring/recording:	Transects are re-sampled every 5 years
Value Applied	As determined from estimated density class- (1) sound, (2) intermediate and (3) rotten.
Monitoring equipment:	Drying oven, scale
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Mass/Volume
Comments:	Used to calculate mass of lying dead wood DOM_{LDW}

Data/parameter	E_M
Data unit	%
Description:	An estimate of model error based on the relative area-weighted difference between model-predicted values of carbon storage and those values measured in field plots
Source of data	Model output and field data
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	At each verification
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).

Calculation method:	Equation 60a of the Project Design Document
Comments:	Used in the calculation of uncertainty factor (Section 4.5)

Data/parameter	E_I
Data unit	%
Description:	An estimate of Inventory sampling error calculated as the 90% confidence limit of the area-weighted differences between the model-predicted values of carbon storage and those values measured in field plots
Source of data	Model output and field data
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	At each verification
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	Equation 60c of the Project Design Document
Comments:	Used in the calculation of uncertainty factor (Section 4.5)

Data/parameter	E_P
Data unit	%
Description:	An estimate of total project error based sum of the model and inventory error terms
Source of data	Model output and field data
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	At each verification
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).

Calculation method:	Equation 60f of the Project Design Document
Comments:	Used in the calculation of uncertainty factor (Section 4.5)

Data/parameter	ER_{y,ERR}
Data unit	%
Description:	The uncertainty factor calculated for year 'y' in Section 4.5
Source of data	Model output and field data
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	At each verification
Value Applied	Variable
Monitoring equipment:	
QA/QC procedures to be applied:	Latest NCC Standard Operating Procedures (SOP).
Calculation method:	As shown in Section 4.5
Comments:	Used in the calculation of VCUs (Section 4.4)

3.3 Description of the Monitoring Plan

The objective of the project monitoring plan is to reliably monitor changes in carbon stocks related to the calculation of VCU's prior to each verification. In particular, the program will monitoring changes in spatial forest inventory conditions and collect field data on carbon stocks to compare against modeled carbon stocks and to calculate an uncertainty factor.

Field based monitoring activities are under taken by NCC staff and contractors under the supervision of NCC. Data analysis and reporting of the monitoring results were undertaken by 3GreenTree Ecosystem Services Ltd. Key staff involved in this monitoring period include:

Contact	Company	Title	Project Responsibilities
Tom Swann	Nature Conservancy of Canada	BC Assoc. Regional VP & Director of Land Securement & Major	Overall responsibility for Darkwoods, NCC carbon lead team.

		Policy Initiatives	
Rob Wilson	Nature Conservancy of Canada	Director, Carbon Finance	Carbon project oversight, carbon sales and marketing, NCC carbon lead team.
Nancy Newhouse, RPBio	Nature Conservancy of Canada	Program Manager, Canadian Rocky Mountains Program, BC Region	Regional manager with direct oversight of Darkwoods operations, regional stakeholder engagement, etc.
Dave Wickstrom, RTF	Nature Conservancy of Canada	South Selkirk Project Manager	Darkwoods operational management. Field monitoring.
Mike Vitt, BScFor, MBA	3GreenTree Ecosystem Services Ltd.	Managing Director	Carbon project development, monitoring management.
Brad Seely, PhD	3GreenTree Ecosystem Services Ltd.	Managing Director	Carbon project development, carbon modeling, monitoring analysis.
Kathleen McGuiness	Touchstone GIS Services Inc.	Principal	Darkwoods GIS data analysis and management.
Trevor Anderson	Timberland Consultants Ltd.	Partner	Monitoring field work.

Implementation of the Darkwoods project monitoring plan contains three primary activities, as described below:

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. Of note is the new inventory undertaken in 2011 that served to fully update the entire property inventory.

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 (Table 5).

The new inventory (see Section 5.1) included information with respect to the impact of Mountain Pine Beetle (MPB) activity within the Darkwoods area. The impact of MPB was represented within the spatial inventory data using a field entitled “MPB” that was derived from an overlay of 2010 spatial data produced by the BC Ministry of Forests and Range mapping the impact of MPB across the region. Each forested inventory polygon was assigned one of the MPB categories described in Table 6. It should be noted that mortality caused by MPB was also picked up during the creation of the new inventory in 2011 where live trees were recorded separately from dead trees in aerial photo interpretation. Special MPB analysis units (see Table 7 and Table 12) were created to represent stands with significantly reduced levels of live tree cover due to mortality. Polygons were assigned to one of the MPB analysis units based upon the criteria outlined in Table 7. Some MPB affected stands were assigned to ‘normal’ analysis units if the measures of crown cover and stand density were high enough considering the age of the live trees. These would include stands with significant understory regeneration or stands that retained an adequate level of crown closure (Table 7).

The approach taken to address the impact of MPB in the 2011-2012 monitoring period is more sophisticated than that applied in the 2008-2010 monitoring report and is reliant upon detailed spatial data. In the former report we had very little spatial data with respect to MPB activity and were forced to represent its impacts based upon the simple highly conservative assumption that all of the pine in lodgepole pine leading polygons would be killed over a three-year period.

No material areas of blowdown, slides, or other (non-MPB) pests/disease were noted on the property.

Table 5. Darkwoods monitored fire events 2011-2012.

Project Year	# Fire Occurrences	Monitored Fire Occurrence (ha)
2011	0	0 ha
2012	0	0 ha

Table 6. Summary of MPB attack severity within the Darkwoods area as of 2010.

MPB Severity Class	Area (ha)
Trace (<1%)	1159.3
Light (1 to 10%)	6513.8
Moderate (11 to 30%)	2621.0
Severe (31-50%)	407.6
Very Severe (>50%)	40.8
None	44051.3

Table 7. Criteria employed to determine whether a polygon was assigned to a MPB analysis unit (AU).

Assigned to MPB AU	Stand Age (y)	Stand density (stems/ha)	Crown closure (%)	MPB Severity ² (%)
Y	< 21	< 500		>10%
Y	> 20		< 31%	>10%

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

NCC undertook timber harvesting, as per the project scenario plan on an annual basis during the monitoring period. The harvest areas were predominantly related to management and salvage of MPB infested pine stands. The harvesting by monitoring period year is shown in **Figure 2** and summarized in **Table 8**. The ex-post area data shown in **Figure 2** are from digitized maps of actual Darkwoods harvest block areas. The projected volume was calculated by FORECAST/ATLAS assuming clearcut harvesting on the planned polygon area with the output. The ex-post delivered harvest volume is from BC Assessment Authority scaling data. There are some differences in the delivered vs. projected harvest volumes due to: 1) the fact the there is within block individual and grouped tree retention in the field that is not represented within the models; 2) small differences in the timing of reporting; 3) differences in projected and actual yields for a given polygon; and 4) differences in projected vs. actual merchantability. However, the simulation of clearcut harvesting with no tree retention is conservative from an ecosystem carbon storage perspective.

² From the MPB inventory field described in Table 6.

Figure 2. Project harvested area 2011-2012

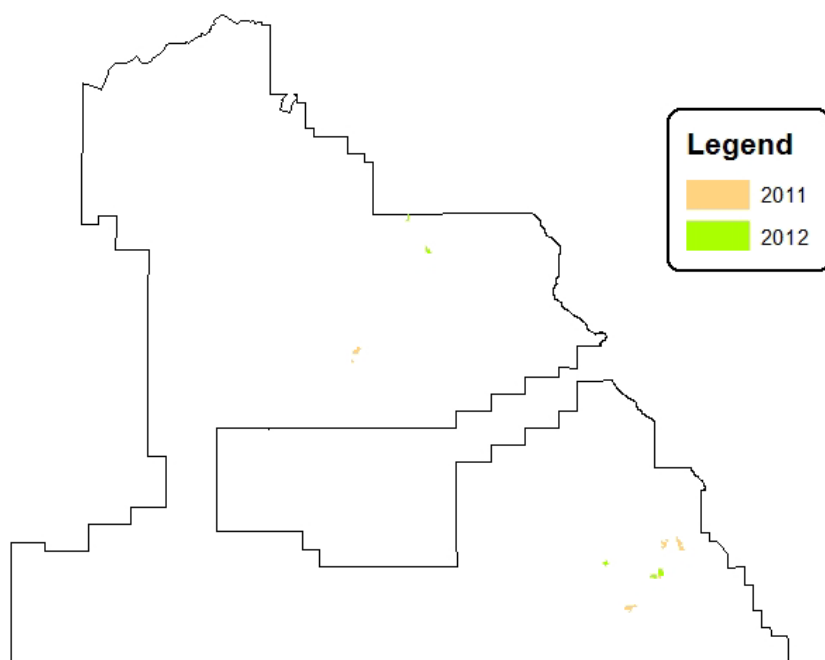


Table 8. Darkwoods Project Harvesting Activities 2011-2012

Project Year	Year	Ex-Post Projected Volume (m ³)	Ex-Post Delivered Volume (m ³)	Ex-Post Actual Area (ha)
4	2011	13,253	11,913	39
5	2012	10,131	14,152	24
	Total	23,384	26,065	63

c. Unplanned man-made disturbances (i.e. non-de minimis illegal or unplanned harvests, etc., if applicable)

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), and implemented a mandatory permit system to monitor access on the property.

2. Other Monitoring Requirements of the Project

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

a. Activity shifting leakage (annually)

NCC has not undertaken any material level of timber harvesting on any owned or managed property outside Darkwoods for the period 2011 to 2012, and therefore there is no risk of starting activity shifting risk (see Table 9).

Table 9. NCC Logging Activity on Other Properties (activity shifting risk) 2011-2012

Property	Project Year	Logging Volume (m ³)	Activity shifting evidence/comment
All NCC properties outside Darkwoods	2011	0.0	n/a – no harvest
All NCC properties outside Darkwoods	2012	0.0	n/a – no harvest

b. Annual market leakage calculations (annually)

Annual Calculations of market leakage are shown for the years 2011-2012 in Section 4.3.

3. Field plot monitoring

a. Type and Number of Sampling Plots

NCC completed the second phase of their field plot implementation installing an additional 51 plots throughout the property during the fall of 2011 to bring the total number of plots on the property up to 67. The circular, fixed-area (4m, 10m, or 14m radius depending on tree size) plots were installed following the procedures defined in the PDD. Further, a full set lying dead wood data were collected for all new plots and for the 16 original plots (only standing dead had been measured during the previous monitoring period due to snow cover during the sampling). The plot network is representative of the productive forest landbase within the Darkwoods project area and covers 17 of the 20 forest analysis units created for projecting forest carbon storage (See Table 2). As described in Section 2.2, the 3 analysis units that do not have plot representation make up less than 3% of the productive landbase.

b. Sampling Design

The field crews were given several sample plot locations using standard GIS software to generate the UTM coordinates of candidate polygons within the Darkwoods landbase. As described in Section 2.2, locations were selected based upon the old inventory (the new inventory was not ready) and with an objective of representation across all analysis units. Crews followed the plot installation and measurement methods as outlined in the Standard Operating Procedures (SOP) document (Section 5.2). Plot size (radius = 4m, 10m, or 4m) was determined based upon the DBH range of the trees within the plots. Crews were instructed to establish a plot center and to measure the top height and DBH of each standing stem with a diameter ≥ 5 cm. Species and tree condition class (Live, Dead, Snag) were also recorded. 'Dead' indicated recently dead with branches still largely intact while 'Snag' indicated a standing dead stem with significant loss of branches. The crew also made note if a stem had a broken top and the recorded the height at break.

The following carbon pools were calculated from plot measurements:

- Live trees: aboveground + belowground
- Standing dead trees: aboveground
- Lying dead wood

c. Measurement and Data Analysis Techniques

Trees: Live & Standing Dead

Tree biomass per hectare for each plot was calculated from equations from (Standish, Manning, & Demaerschalk, 1985) that relate biomass to DBH and height for the 22 main tree species in British Columbia. The Standish equations, published in a peer-reviewed report, represent the standard for estimating biomass in British Columbia tree species and have been cited in several recently published, peer-reviewed papers in which tree biomass is calculated (e.g. Fredeen et al. 2005; Seely et al. 2008³). The form of the Standish Equation is as follows:

$$Y_i = a + b(D^2H)$$

where:

Y_i = Component biomass – in the case of live trees the a and b parameters are provided for the total aboveground biomass of the measured tree; in the case of dead trees or snags a and b parameters are provided for each component i – see Table 10. (kg dry mass)

D = Diameter at breast height (1.3m) (m)

H = top height of tree (m)

a = the intercept of the equation

b = the slope of the equation

The components for the Standish et al. (1985) equations were selected based upon tree class as shown in Table 10. A subset of 3 -5 dominant/co-dominant canopy trees within each plot were cored and aged to provide an estimate of stand age. The raw plot data for the each of the 67 plots are made available in a supporting file referenced in Section 5.

Belowground biomass ($t\ ha^{-1}$) was calculated from live aboveground biomass using equations derived from (Li, Kurz, Apps, & Beukema, 2003) and (Lehtonen, Makipaa, Heikkinen, Sievanen, & Liski, 2004). Tree-level measurements (kg biomass per tree) were converted to area-based stand-level measurements ($t\ ha^{-1}$) and a conversion factor (0.50) was used to convert biomass into carbon. A detailed description of the equations used in these calculations can be found in Section 3.4 of the PDD. The application of the biomass and carbon calculations are shown in the sample plot data spreadsheet referenced in Section 5.

³ Fredeen A. L., C. H. Bois, D. T. Janzen, and P. T. Sanborn. (2005). Comparison of coniferous forest carbon stocks between old-growth and young second-growth forests on two soil types in central British Columbia, Canada. *Can. J. For. Res.* 35: 1411–1421.

Seely B., C. Hawkins, J.A. Blanco, C. Welham, J.P. Kimmins. (2008). Evaluation of a mechanistic approach to mixedwood modelling. *Forestry Chronicle* 84: 181-193.

Table 10. List of components used to calculate biomass in the Standish et al. (1985) biomass equations.

Class	Components used (a & b) ⁴	Belowground included ⁵
Live	DTOTAL	yes
Dead	DWOOD + DBRAN1	no
Snag	DWOOD	no

Lying Dead Wood

The mass of lying dead wood was measured in the permanent sampling plots using the line intersect method as described in the SOP document (Section 5.2). The diameters of all pieces of wood ≥ 5 cm diameter intersected by the transect lines were measured and recorded. Each piece of deadwood was assigned to one of three density classes, sound (0.43 t m^{-3}), intermediate (0.34 t m^{-3}), and rotten (0.19 t m^{-3}). The raw data and calculations are available in the file referenced in Section 5.2. A description of the detailed methodology and equations used in the calculation of lying dead wood is provided in the Section 3.3 of the PDD.

d. Quality Assurance/Quality Control Measures (QA/QC)

Data gathered through the monitoring process were used for two main purposes:

- 1) to improve calculations of carbon stocks by fine-tuning the representation of each of the forest analysis units within the FORECAST model (see Section 3.4 of the PDD)
- 2) to evaluate the quality of the inventory and models through the calculation of the uncertainty factor described in Section 3.5 of the PDD

QA/QC for Field Measurements

In the Fall of 2011 NCC undertook a blind check cruise program, which resulted in 11 plots being 100% re-sampled, including re-counting the plot tree core ages. DBH, Height, and Age measurements met the accuracy threshold of $\pm 10\%$ at 90% CI, as required by the PDD (See Section 5.2). The raw QAQC plot data are available in the file referenced in Section 5.2.

QA/QC for Data Entry

NCC standard procedures and ongoing QA/QC programs for data will be followed to ensure proper entry and transfer of data in electronic format. If there are anomalies that cannot be resolved, the

⁴ The Standish et al. (1985) equations include different sets of component values depending on which biomass components are required. DTOTAL = total tree dry mass, DWOOD = stemwood dry mass, DBRAN1 = dry mass of large branches ($>2.5\text{cm}$)

⁵ Belowground biomass was estimated from aboveground biomass for live stems only. Dead stems and snags were assumed to have no live belowground biomass (only dead belowground biomass which is not included in the monitoring program).

plot will be re-measured or omitted from the analysis. No unresolvable anomalies were found in the check cruise program, or during data analysis for this monitoring period.

QA/QC for Data Archiving

NCC has stored the electronic field data files, summary Excel files, and age core samples at the Darkwoods field office. GIS and related property spatial data are stored at NCC and Touchstone GIS offices.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Pre-stratification of Land Area

With the development of the new inventory (Section 5.1) it was necessary to 'pre-stratify' the landbase into broad classes necessary to define the harvestable landbase according to regional standards. The following steps were taken in this process. These are similar to the steps that were taken with the previous inventory with a few minor exceptions as noted below.

1. Identify forested area - The identification of forested area was achieved by adding a new field 'Forested' and assigning polygons that contained tree species data in the field 'TREE_SPECIES_CODE_1' a value of "Y".

2. Identify operable landbase - The spatial boundary of the adjusted operable landbase (as defined in the PDD) was added to the new inventory using an overlay procedure.

3. Identify economically viable stands – Following regional standards and the approach outlined in the PDD, stands that would be considered uneconomical to harvest were identified. These included all hardwood stands and stands in which the leading species was either western hemlock, western red cedar, or subalpine fir and for which the stand age was >159y. In the 2008-2010 monitoring period, stands in age classes 8 or 9 (age >140) with the leading species mentioned above were assumed to be uneconomical. The 159y cutoff is more consistent with regional standards and feedback from Darkwoods foresters.

4. Identify road and stream buffers - Following regional standards and using existing spatial (linear) data for roads and streams within the Darkwoods property, road and stream buffers (polygons) were created to define area that was not forested or could not be harvested. Road buffers were created using a 5m buffer on either side of the centerline. Stream buffers were created in the same way using a 3m buffer.

5. Age adjustment for partially harvested stands – To avoid over estimating carbon storage, any stands identified as partially harvested in the past had their age reset to an age determined by the time of logging if the crown closure field was < 21%.

6. Identify non-productive forest area - Following regional standards forested polygons were classified either as productive or non-productive. The criteria outlined in Table 11 were used to determine if stands were non-productive. In the previous inventory used in the 2008-2010

monitoring report, non-productive forest had already been identified in the spatial dataset. There was little documentation with respect to the criteria employed.

7. Correct for 2008-2010 harvesting in the baseline scenario – To avoid re-harvesting areas that had already been modeled as harvested in the baseline scenario modeled for the previous monitoring period (2008-2010), it was necessary to update the new inventory to reflect previous harvesting during this period. This was done by creating a copy of the new inventory dataset and updating it to account for the 2008-2010 spatial harvesting that was modeled for the baseline scenario in the previous monitoring report. Specifically, the spatial harvesting map⁶ created by FPS-ATLAS for the 2008-2010 period (based upon the old inventory) was overlaid upon the new inventory (Figure 3). Previously harvested polygons were identified in the new inventory and their ages were reset to 1 to indicate they had been harvested. In addition, analysis units were reassigned according to the transitions outlined in Table 13. This corrected baseline inventory was used as the starting point for the projection of the current baseline scenario from 2010 onward. The original version of the new inventory (without the baseline harvesting corrections and which represents the ex-post project conditions) was used for the simulation of the project scenario. Both the baseline and project version of the new inventory are included in the spatial data set referenced in Section 5.2.

⁶ Note that the 2008-2010 spatial harvested areas modeled in the baseline scenario represent the areas selected for harvest by the ATLAS model based on selecting forest inventory polygons to achieve the target baseline annual harvest volume using the selection criteria described in the PDD. These areas are shown spatially in Figure 3 for the purpose of explaining the transition of the baseline scenario to the new inventory, but are not intended to represent an specific annual operational harvest plan (which would include operational efficiency elements and other detailed planning elements) and should not be interpreted as such.

Figure 3. Representative Area harvested in the baseline scenario during the previous monitoring period 2008-2010.

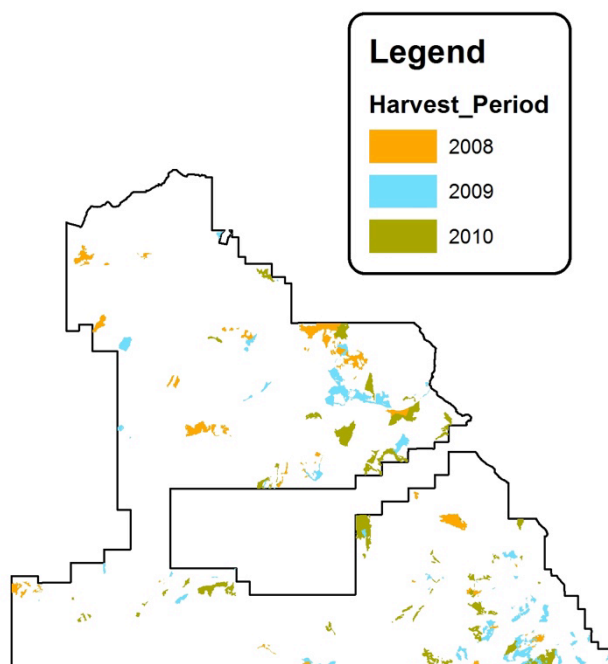


Table 11. Summary of non-productive forest area by criterion.

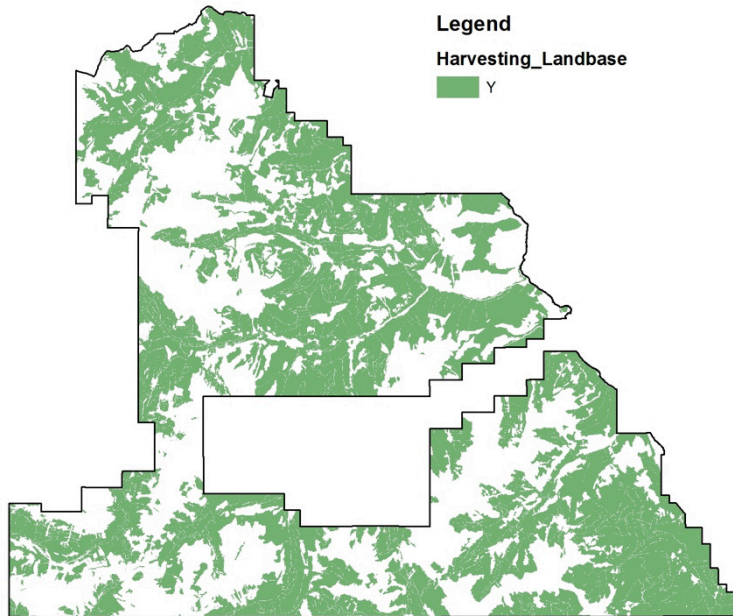
Criterion	Area affected (ha) ⁷
Site index too low (SI<8)	9,127.2
Tree cover too low (<75%) based upon land cover class field	483.8
Non-sufficient Regeneration (NSR)	463.4
Road & Stream buffers	1,185.4
Low crown closure (< 20%) in mature stands	3,554.1
Non-forested	2,019.6
Total Non-productive forest	14,482.1

Definition of the Harvesting Landbase

The harvestable landbase was defined to include forested polygons that met all of the following criteria: 1) must be defined as productive forest, 2) must be defined as economical, and 3) must be within the boundary of the operable landbase. A spatial map of the resulting harvesting landbase is shown in Figure 4.

⁷ There is area overlap among the different criteria.

Figure 4. The area defined as the harvestable landbase for the Darkwoods property.



Stratification of Forested Area for Carbon Analysis

The project land base was stratified using an analysis unit approach as described in Section 4.1 of the PDD. Following the creation of the new inventory the carbon analysis units were updated and are slightly different than those employed in the previous monitoring report. Specifically, the following changes were made:

- 1) the old AUs 210 (managed hardwood leading stands) were combined with AU 110 (natural hardwood leading stands as there was almost no representation in AU 210 and no harvesting of hardwood stands (same applies to AU 310).
- 2) The Old AU 204 (Poor managed conifer leading) was changed to split out the pine leading managed stands to AU 206 (medium managed pine leading) as these types represented a significant area in the new inventory and the 204 analysis unit had been underestimating biomass in this type (same applies to AU 304 / AU306).
- 3). The Old AUs 405a and 405b (poor MPB attacked stands) were combined with 406a and 406b (medium MPB attacked stands), respectively as there was very little of AU 405 in the new inventory and the model had been underestimating biomass in this type.
- 4) The old AU 103 (conifer leading poor) was split to exclude stands that would be considered non-productive due to a SI < 8m. A new unit AU 111 was created to represent these non-productive conifer leading types.

The criteria used to assign the analysis units to the forested inventory polygons are shown in Table 12. A breakdown of the productive and non-productive forest area within each analysis unit is provided in Table 2. The regeneration assumptions used to simulate the analysis units in the FORECAST model are shown in Table 13; the transition rules following harvest are also provided. All of the analysis units were simulated using FORECAST v8.4 and effectively updated relative to the model output used in the 2008-2010 monitoring report. The specific carbon storage and yield curves generated for each analysis unit are included in a file referenced in Section 5.2.

Table 12. Assignment criteria for carbon analysis units.

AU	Description ⁸	Lead	other sp.	Prod class	SI range ⁹	Age ¹⁰
none	non-forest					
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	PL_med	PL	F, S	med	>12	>40
107	CW / HW_med-good	CW / HW	S,F	med-good	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	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	med-good	all	<=40
209	S_good	S	F, H, C	good	>16	<=40
	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

⁸ F = Douglas-Fir, L = Western Larch, B = Subalpine Fir, S = Hybrid spruce or Engelmann Spruce, P = Lodgepole pine and White bark pine, C = Western red cedar, H = Western hemlock, E = Paper birch, and A = Trembling aspen.

⁹ Site Index based on height at breast-height age 50.

¹⁰ The Age field is used to distinguish managed from natural stand types.

Table 13. Regeneration assumptions and transition rules (following harvest) for each analysis unit.

Natural Stands													
AU	Description	SI	Sp1	Sp2	Sp3	Sp1 %	Sp2 %	Sp3 %	Density	Regen delay	Endemic mort	Trans 1 ¹¹	Trans 2 ¹²
101	F / L_med	16	Fd	PI		75	25		1200	4	0.04	201	301
102	F / L_good	22	Fd	Hw	Cw	70	20	10	1600	3	0.04	202	302
103	B / L / F_poor	12	Bl	Se		75	25		1200	6	0.03, 0.05	203	303
104	B_med	16	Bl	Se		65	35		1800	4	0.03, 0.05	204	304
105	P_poor	12	PI	Bl		70	30		1900	3	0.03	206	306
106	P_med	17	PI	Se		70	30		2000	3	0.03	206	306
107	C / H_med-good	18	Hw	Cw		60	40		2000	3	0.06	207	307
108	S_med	16	Se	Bl	PI	60	20	20	1500	6	0.03, 0.05	204	304
109	S_good	22	Sx	Fd	Cw	50	30	20	1600	5	0.04	209	309
110	E / A_Med	16	Ep	At		75	25		2000	2	0.03	110	110
111	B_very poor	7	Bl	Se		75	25		1000	6	0.03, 0.05	111	111
Managed Stands													
AU	Description	SI	Sp1	Sp2	Sp3	Sp1 %	Sp2 %	Sp3 %	Density	Regen delay	Endemic mort	Trans 1	Trans 2
201	F / L_med	16	Fd	PI		75	25		1500	1	0.04	201	301
202	F / L_good	22	Fd	Hw	Cw	70	20	10	2000	1	0.04	202	302
203	S/P/B poor	12	Se	Bl	PI	40	35	25	1600	1	0.03, 0.05	203	303
204	S/P/B Med	16	Se	Bl	PI	40	35	25	1600	1	0.03, 0.05	204	304
206	P_med	17	PI	Se	Bl	60	30	10	2000	1	0.03, 0.05	206	306
207	C / H_med-good	18	Hw	Cw		60	40		2000	1	0.06	207	307
209	S_good	22	Sx	Fd	Cw	50	30	20	2000	1	0.04	209	309
Harvest no plant													
AU	Description	SI	Sp1	Sp2	Sp3	Sp1 %	Sp2 %	Sp3 %	Density	Regen delay	Endemic mort	Trans 1	Trans 2
301	F / L_med	16	Fd	PI		75	25		1000	6	0.04	301	301
302	F / L_good	22	Fd	Hw	Cw	70	20	10	1200	5	0.04	302	302
303	S/P/B poor	12	Se	Bl	PI	40	35	25	800	8	0.03, 0.05	303	303
304	S/P/B Med	16	Se	Bl	PI	40	35	25	1000	6	0.03, 0.05	304	304
306	P_Med	17	PI	Se	Bl	60	30	10	1500	4	0.03, 0.05	306	306
307	C / H_med-good	18	Hw	Cw		60	40		1400	5	0.06	307	307
309	S_good	22	Sx	Fd	Cw	50	30	20	1000	7	0.04	309	309

Calculation of annual emissions/reductions

¹¹ Used in the simulation of the project scenario.

¹² Used in the simulation of the baseline scenario.

Annual emissions/reductions for the baseline scenario for the years 2011-2012 were calculated using the output from the FPS-ATLAS model simulation. The baseline scenario was modeled using the same assumptions laid out in the PDD. Output with respect to volume harvested and annual emissions/reductions (including key components) are shown in Table 14. A link to the detailed FPS-ATLAS output file is provided in Section 5.2.

Table 14. Annual emissions/reductions for the baseline scenario calculated for 2011-2012.

Year	Ann. Baseline (Emissions) Reductions (tCO ₂ e)	Volume Harvested (m ³)	Baseline Net Change in Ecosystem C (tC)	Baseline Storage HWP (tC)	Baseline Storage Waste Products (tC)	Baseline (Emissions) Production & Waste (tC)
2011	(297,264)	300,572	(82,335)	4,009	1,154	(3,826)
2012	(300,470)	300,707	(83,209)	4,010	1,154	(3,828)

4.2 Project Emissions

Stratification of Land Area

The project land base was stratified using the same analysis unit approach as described in Section 4.1.

Calculation of annual emissions/reductions

Annual emissions/reductions for the project scenario for the years 2011-2012 were calculated using the output from the FPS-ATLAS model simulation. Harvested areas in the project simulation were defined using the spatial annual harvest data from the inventory (see Figure 2). Output with respect to volume harvested and annual emissions/reductions (including key components) are shown in Table 15. A link to the detailed FPS-ATLAS output file is provided in Section 5.2.

Table 15. Annual emissions/reductions for the project scenario calculated for 2011-2012.

Year	Ann. Project (Emissions) Reductions (tCO ₂ e)	Volume Harvested (m ³)	Project Net Change in Ecosystem C (tC)	Project Storage HWP (tC)	Project Storage Waste Products (tC)	Project (Emissions) Production & Waste (tC)
2011	138,484	11,914	37,681	159	46	(152)
2012	127,026	14,152	34,549	189	54	(180)

4.3 Leakage

Market Leakage

The market leakage factors were calculated using Option 2 – CAR Leakage Calculation (See link to the spreadsheet file in which leakage calculations were made in Section 5.2). This market leakage option does not require further monitoring activities, other than monitoring actual scenario harvest volumes (shown in

Table 8). The resulting leakage risk factors determined for each monitoring period year are shown in Table 16.

Table 16. Annual Market Leakage Discounts for the 2011-2012 monitoring period.

Year	Change in carbon associated with harvested wood (tCO ₂ e)	Leakage Risk Discount (tCO ₂ e)	Leakage Risk % of VCUs
2011	211,875	(42,375)	9.7%
2012	210,331	(42,066)	9.8%

4.4 Summary of GHG Emission Reductions and Removals

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 PDD. The results for the 2011-2012 verification period are shown in Table 17. The spreadsheet used to calculate the values shown in Table 17 is referenced in Section 5.2.

Table 17. Total saleable VCUs and terms used in their calculation for the 2011-2012 verification period.

Year	Ann. Net Emissions Reductions (tCO ₂ e)	Leakage Risk Discount (tCO ₂ e)	Uncertainty Risk Discount (tCO ₂ e)	Annual Buffer Set-Aside (tCO ₂ e)	Cumulative Buffer Account (tCO ₂ e)	Release From Buffer (tCO ₂ e)	Saleable VCU (tCO ₂ e)
2011	435,748	(42,375)	(5,901)	(42,226)	147,253	0	345,246
2012	427,496	(42,066)	(5,781)	(41,411)	188,664	0	338,237

4.5 Calculation of the Uncertainty Factor

As described in Section 3.5 of the PDD, an Uncertainty Factor including inventory and model error terms were calculated based upon the comparison of the stand-level measures of net aboveground ecosystem C within the field plots and the associated model-projected values. A total Project error (EP) of 3.2% was determined as the sum of the calculated Inventory error (EI) term of 9.5% and a model error (EM) term of – 6.3%. Thus, the value of the Uncertainty Factor was determined to be 1.5% based upon equation below. Both the model error terms and the inventory error terms are improved relative to the last verification period due to the expansion of

the plot network from 15 to 66 plots and the updating of the inventory data. The model error term was slightly negative (under predicting carbon storage) relative to the inventory plots.

As described in Section 3.5 of the PDD the Uncertainty Factor is determined from the inventory and model error terms as follows:

Uncertainty Factor =

If $EP < 10\%$ then 1.5% ;

If $EP > 10\%$ then $1.5\% + EP - 10\%$

where:

$EP = EI + EM$

EP = Total project error (%)

EI = Inventory error at the 90% confidence interval (% , expressed as the absolute value of the $\pm$ error term).

EM = Model error (%). May be positive (model > measured value) or negative (model < measured value).

The spreadsheet used in the calculation of the Uncertainty Factor is referenced in Section 5.2.

5 ADDITIONAL INFORMATION

5.1 Creation of the new inventory

In 2011, Nature Conservancy Canada engaged Ecora Resource Group Ltd (Ecora) to complete an integrated Vegetation Resource Inventory (VRI) and Terrestrial Ecosystem Mapping (TEM) project on the Darkwoods property. One of the stated objectives was to improve the overall quality of the spatial forest vegetation data in support of ongoing forest resources management. Aerial photography was acquired for the property in July 2011. The product included high-resolution digital imagery (20cm) and a high-resolution ortho-photo. The digital imagery in combination with a field sampling regime were used as the basis to create the VRI data which were used to support the continued monitoring of the Darkwoods forest carbon project. The complete report describing the development of VRI and TEM data is provided as a supporting document entitled: "Vegetation Resource Inventory And Terrestrial Ecosystem Mapping For The Darkwoods Property, British Columbia: Final Report" and dated April, 2012.

5.2 Supporting Files and Additional Information

A list of supporting files used in the calculation of carbon offsets for the 2011-2012 period is provided in Table 18. The names of worksheets in which specific data and/or calculations are located are also shown.

Table 18. Supporting files used in the calculation of carbon offsets for the 2011-2012 period.

Description	File Name	Worksheet
Tree measurement data from monitoring plots	Darkwoods plot data Aug 2012 v1.2.xlsm	Tree data
Tree-level biomass calculations	Darkwoods plot data Aug 2012 v1.2.xlsm	Tree data
Deadwood mass calculations	Darkwoods plot data Aug 2012 v1.2.xlsm	CWD data
Stand-level biomass & carbon calculations	Darkwoods plot data Aug 2012 v1.2.xlsm	C Analysis
Uncertainty Factor calculations	Darkwoods plot data Aug 2012 v1.2.xlsm	Uncertainty Factor
QA Check Plot Data	NCC Darkwoods_QA_Carbon Plots_2011.xlsx	Tree Data; CWD data
QA Check Plot analysis	NCC Darkwoods_QA_Carbon Plots_2011.xlsx	Tree comparison; CWD comparison
ATLAS Carbon output	ATLAS Runs updated Dec 2012.xlsx	Carbon_2012
ATLAS Volume output	ATLAS Runs updated Dec 2012.xlsx	Growing stock_2012
ATLAS Harvest flow	ATLAS Runs updated Dec 2012.xlsx	Harvest
Calculation of C storage and emissions associated with the production of HWP	Darkwoods Carbon Model 2011-12 v1.2.xlsx	HWP Carbon Model
Calculation of Market Leakage	Darkwoods Carbon Model 2011-12 v1.2.xlsx	Summary Tables & Figures
Calculation of Saleable VCUs	Darkwoods Carbon Model 2011-12 v1.2.xlsx	Summary Tables & Figures
Carbon field plot sampling standard operating procedures	Darkwoods Carbon Field Plot SOP - Draft 1.2.docx	N/A
Darkwoods Data Standards	Darkwoods Data Standards_30Nov09.doc	N/A
New Spatial Inventory for the Darkwoods Project Area	Darkwoods_VRI_Resultant_Oct2012_v2.3.mdb.zip	N/A
VCS Risk Report Tool	VCS Risk Report Calculation Tool, v3.0 – Darkwoods 2011-12.pdf	N/A
VCS Non-Permanence Risk Report	VCS Non-Permanence Risk Report (Short) – Darkwoods 2011-12 Verification v.1.1.pdf	N/A