Finite Carbon – Loon Echo & Mahoosuc Land Trusts IFM

November 14, 2022

Table of Contents

A.
PROJECT OVERVIEW

A1. PROJECT TITLE

The project title is "Finite Carbon – Loon Echo & Mahoosuc Land Trusts IFM."

A2. PROJECT TYPE

This project is an Improved Forest Management (IFM) project, under the American Carbon Registry Standard[1] and the Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal Forestlands.[2]

A3. PROOF OF PROJECT ELIGIBILITY

Eligibility for this Improved Forest Management project has been determined with reference to the ACR Standard Version 7.0 and Improved Forest Management for Non-Federal U.S. Forestlands Version 1.3. Finite Carbon – Loon Echo & Mahoosuc Land Trusts IFM project meets all relevant eligibility requirements as described in Table A3.1 below. Additionally, the project has not applied for and been listed, registered, and/or been issued GHG emission reduction or removal credits through any other GHG emissions program.

TABLE A3.1: PROJECT ELIGIBILITY REQUIREMENTS

Eligibility Criterion	Proof of Eligibility	Reference
Start Date	The project has a start date of October 8, 2021, the date on which a Carbon Development Services Agreement between the Project Proponent and a purchaser of the ERTs was fully executed.	H1. START DATE
Minimum Project Term	The Project Proponent commits to project continuance, monitoring, and verification for at least the required Project Term of 40 years.	H2. PROJECT TIMELINE
Crediting Period	In compliance with ACR Standard Version 7.0, the	H2. PROJECT TIMELINE

[1] ACR. 2020. American Carbon Registry Standard, Version 7.0. American Carbon Registry, Arlington, VA, USA.
[2] ACR. 2018. Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal Forestlands, Version 1.3, April 2018, American Carbon Registry, Arlington, VA, USA.

TABLE A3.1: PROJECT ELIGIBILITY REQUIREMENTS		
	crediting period for the project is 20 years.	
Real	GHG removals are quantified based on inventory of the standing carbon stocks in the project area (ex post).	D. MONITORING PLAN and E. QUANTIFICATION
Emission or Removal Origin	Emissions reductions or enhanced removals created by the project activity are generated from forest carbon sources and sinks over which the Project Proponent has control.	G1. PROOF OF TITLE and Appendix A. Ownership Documentation
Offset Title	Emissions reductions or enhanced removals created by the project activity are owned directly by the Project Proponent.	G1. PROOF OF TITLE
Additional	Additionality for the project has been demonstrated through a regulatory surplus test, a common practice test, and an implementation barrier test.	C. ADDITIONALITY
Regulatory Compliance	The Project Proponent has adhered to all laws, regulations, and other legally binding mandates directly related to Project Activities.	ACR701 Regulatory Compliance Attestation
Permanent	Permanence is addressed by the project through ongoing assessment of risk using the ACR Tool for Risk Analysis and Buffer Contribution and	B8. PERMANENCE

TABLE A3.1: PROJECT ELIGIBILITY REQUIREMENTS		
	contributions to the ACR buffer pool.	
Net of Leakage	Possible leakage effects are accounted for in accordance with the ACR IFM Methodology.	E3. LEAKAGE
Independently Validated/Verified	The project will be independently validated and verified by an ACR-accredited Validation and Verification Body.	
Environmental and Community Assessments	Impacts on community and environment were assessed in accordance with the ACR Standard and net positive impacts were confirmed.	F. COMMUNITY & ENVIRONMENTAL IMPACTS
Ownership Type	The project ownership is private non-federal U.S. forestland.	G1. PROOF OF TITLE
Project area meets the definition of Forestland condition as per USFS FIA program definition	The project area meets the ACR definition of forestland with a minimum of 10% forest cover (or equivalent stocking) by live trees of any size.	A4. LOCATION

A4. LOCATION

The project is located in southwestern Maine and northeastern New Hampshire, spanning Cumberland and Oxford Counties in Maine, and Coos County in New Hampshire.

Detailed maps describing the project location, hydrology, canopy cover, topography, roads, and ownership boundaries are provided in Appendix C. Project Maps and general maps showing the project area boundaries are provided below.

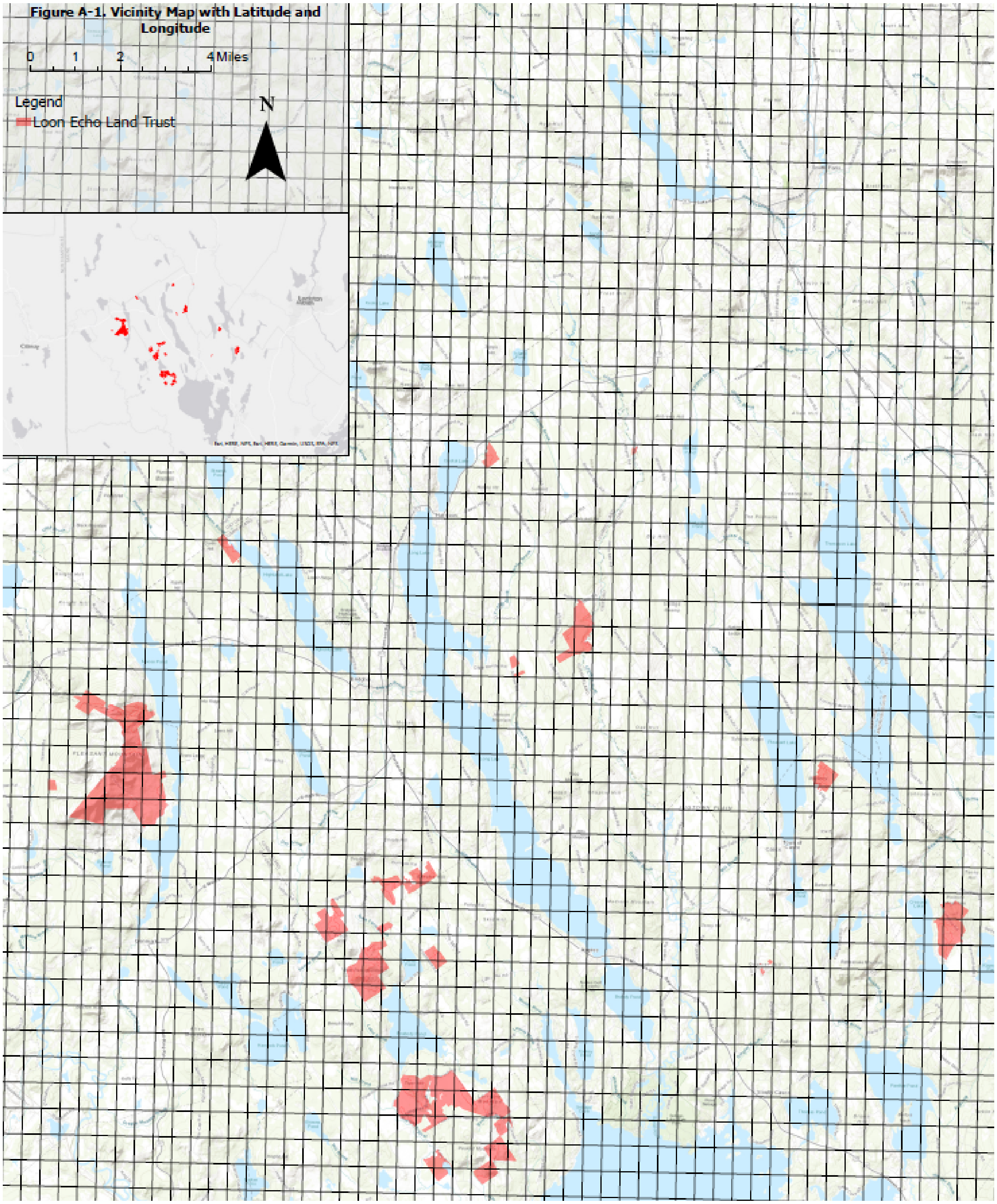


Figure A-1. Vicinity Map with Latitude and Longitude
0 1 2 4 Miles
Legend
Loon Echo Land Trust
N

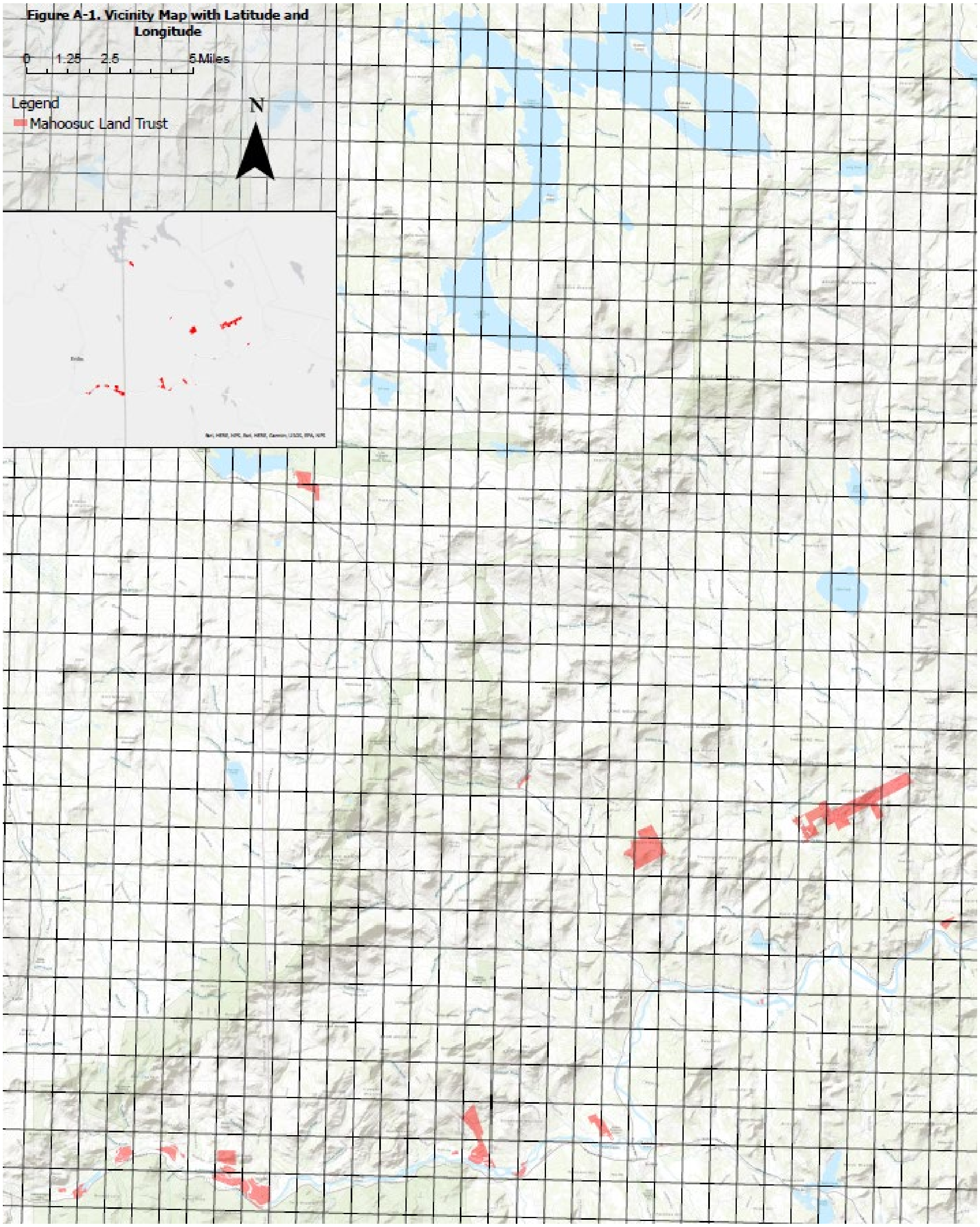


Figure A-1. Vicinity Map with Latitude and Longitude
0
1.25
2.5
5 Miles
Legend
Mahoosuc Land Trust
N

A5. BRIEF SUMMARY OF PROJECT

The project is a joint effort between Loon Echo Land Trust and Mahoosuc Land Trust to combine forestland and facilitate entry into the carbon market and increase land conservation alongside carbon sequestration. These two 501(c)(3) non-profit organizations have similar conservation missions, work in the same region of Maine, and are accredited by the Land Trust Accreditation Commission. The project is the first to arise from the Carbon Offset Pilot Program, a partnership between Finite Carbon and Land Trust Alliance. The project area is dominated by a mix of hardwood (maple/beech/birch) and softwood (spruce/pine/fir) forest types typical of Maine forests. The land trusts manage the land as model forests, focused on public access, general health, habitat, species, age-class and structural diversity and quality timber production over long rotations, along with revenue generation to facilitate land conservation and stewardship.

A6. PROJECT ACTION

The Project Proponent's management provides significant recreational, ecological, and environmental benefits, including the maintenance of large blocks of forest and wildlife habitat. Through a commitment to maintaining and enhancing forest carbon stocks above the baseline level, the project will provide significant climate benefits through carbon sequestration. The project will achieve GHG removals by sequestering more atmospheric CO_2 than a baseline scenario in live aboveground biomass, belowground biomass, and standing dead wood. Actions include, but are not limited to, deferred harvesting, lengthened rotations, timber stand improvement, retention of standing dead wood during timber harvests, and protection of riparian areas, wetlands, and significant natural communities. Forest management will maintain and enhance habitat for a variety of wildlife through snag retention, retention of mast-bearing species, recruitment of coarse woody debris, and the maintenance of wildlife corridors. Water and soil quality will be protected through management that meets or exceeds best management practices in Maine and New Hampshire.

A7. *EX ANTE* OFFSET PROJECTION

Total projected GHG removal is 706,515 mtCO2e (before risk buffer contribution) over the first crediting period of 20 years (including GHG removal from long-term wood products). Table E5.1 lists the estimates of GHG emissions reductions per year.

A8. PARTIES

The project was implemented by Loon Echo Land Trust and Mahoosuc Land Trusts (the landowners and Project Proponents), and Finite Carbon, the carbon offset project developer. Project verification was completed by SCS Global Services. The forest carbon inventory was conducted by Sewall Forestry Consulting.

PROJECT PARTICIPANTS	POINT OF CONTACT	ROLES AND RESPONSIBILITIES	CONTACT INFORMATION
Loon Echo Land Trust	Matt Markot	Project Proponent	8 Depot St, Suite 4 Bridgton, ME 04009 (207) 647-4352
Mahoosuc Land Trust	Kirk Siegel	Project Proponent	162 North Rd, P.O. Box 981 Bethel, ME 04217 (207) 824-3806
Finite Carbon	Paul Noah	Project Developer / Technical Consultant	435 Devon Park Drive 700 Building Wayne, PA 19087 (763) 744-7556
Sewall Forestry Consulting	Ernest Bowling	Inventory Contractor	1141 Main Street, PO Box 554 Old Town, ME 04468 (207) 745-9927
SCS Global Services	Christie Pollet-Young	Validation / Verification Body	2000 Powell Street, Ste. 600 Emeryville, CA 94608 (510) 452-8000

B.

METHODOLOGY

B1. APPROVED METHODOLOGY

The Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal Forestlands (hereafter referred to as the "methodology").

B2. METHODOLOGY JUSTIFICATION

Note the project does not occur on tribal land or a public non-federal ownership. Therefore, those applicability conditions are not considered here. All applicability for private forestland under the selected methodology are fulfilled by the project.

APPLICABILITY CONDITION	DEMONSTRATION OF COMPLIANCE
Applicable only on non-federally owned forestland within the United States	The project area is non-federally owned private forestland.
Applies to lands that can be legally harvested by entities owning or controlling timber rights on forestland	The forestland owner/Project Proponent controls the timber rights on the project area and can legally harvest.
Sustainable harvest requirements	The project area has been actively enrolled in the ATFS program throughout all commercial harvest activities, which meets the criteria established in the IFM Methodology and the 2021 Errata and Clarifications.
Use of non-native species is prohibited where adequately stocked native stands were converted for forestry or other land uses after 1997	There is no use of non-native species where adequately stocked native stands were converted for forestry or other land uses after 1997.
Draining or flooding of wetlands is prohibited	There is/will be no draining or flooding of wetlands on or after the project Start Date.
Project Proponent must demonstrate its ownership or control of timber rights at the project start date	See Appendix A. Ownership Documentation
The project must demonstrate an increase in on-site stocking levels above the baseline condition by the end of the Crediting Period	Stocking levels increase well above the baseline conditions for the duration of the project and by the end of the Crediting Period (E. QUANTIFICATION)

B3. PROJECT BOUNDARIES

The physical project boundaries include 8,568.3 acres of forestland, shown in the maps in Appendix C. Maps and in the geodatabase "ACR735_RP1.gdb."

See H2. PROJECT TIMELINE for the temporal boundaries of the project.

B4. IDENTIFICATION OF GHG SOURCES AND SINKS

CARBON POOLS	INCLUDED / OPTIONAL / EXCLUDED	JUSTIFICATION / EXPLANATION OF CHOICE
Above-ground biomass carbon	Included	Major carbon pool subjected to the project activity.
Below-ground biomass carbon	Included	Major carbon pool subjected to the project activity.
Standing dead wood	Included/Optional	Major carbon pool in unmanaged stands subjected to the project activity. Project Proponents may also elect to include the pool in managed stands. Where included, the pool must be estimated in both the baseline and with project scenarios. For this project, standing dead wood will be included in all stands for both scenarios
Lying dead wood	Optional	Project Proponents may elect to include the pool. Where included, the pool must be estimate in both the baseline and with project cases. For this project, lying dead wood will not be included.
Harvested wood products	Included	Major carbon pool subjected to the project activity.
Litter/Forest floor	Excluded	Changes in the litter pool are considered de minimis

CARBON POOLS	INCLUDED / OPTIONAL / EXCLUDED	JUSTIFICATION / EXPLANATION OF CHOICE
		as a result of project implementation.
Soil organic carbon	Excluded	Changes in the soil carbon pool are considered de minimis as a result of project implementation.

GAS	SOURCE	INCLUDED / EXCLUDED	JUSTIFICATION / EXPLANATION OF CHOICE
CO_2	Burning of biomass	Excluded	However, carbon stock decreases due to burning are accounted as a carbon stock change.
CH_4	Burning of biomass	Included	Non-CO2 gas emitted from biomass burning.
N_2O	Burning of biomass	Excluded	Potential emissions are negligible.

LEAKAGE SOURCE		INCLUDED / OPTIONAL / EXCLUDED	JUSTIFICATION / EXPLANATION OF CHOICE
Activity-Shifting	Timber harvesting	Excluded	Project Proponent must demonstrate no activity-shifting leakage beyond the *de minimis* threshold will occur as a result of project implementation.
	Crops	Excluded	Forestland eligible for this methodology do not produce agricultural crops that could cause activity shifting.

LEAKAGE SOURCE		INCLUDED / OPTIONAL / EXCLUDED	JUSTIFICATION / EXPLANATION OF CHOICE
	Livestock	Excluded	Grazing activities, if occurring in the baseline scenario, are assumed to continue at the same levels under the project scenario and thus there are no leakage impacts.
Market Effects	Timber	Included	Reductions in project outputs due to project activity may be compensated by other entities in the marketplace. Those emissions must be included in the quantification of project benefits.

B5. BASELINE

The baseline scenario represents a plausible harvest regime typical of similar forest types and ecological conditions. The baseline maximizes net present value at a discount rate of 4%, typical of practices in this project region on industrial and private lands. More information on the baseline scenario is provided in E1. BASELINE.

B6. PROJECT SCENARIO

The project scenario consists of managing the forestland to sustainably generate timber products while providing significant recreational, ecological, and environmental benefits, including the maintenance of large blocks of forest and wildlife habitat. See A6. PROJECT ACTION for more information.

B7. REDUCTIONS AND ENHANCED REMOVALS

The project will achieve greenhouse gas reductions by increasing stocking relative to the baseline, via improved forest management practices previously described in A6. PROJECT ACTION.

B8. PERMANENCE

Project Proponents must conduct their risk assessment using the ACR Tool for Risk Analysis and Buffer Determination. Forest project types must claim a value from all eight risk categories.

1. Management and Governance Risks: All project types must select one value form each risk category that applies:

A	**Financial**	• **4% Default Value** • **3% US Public and Tribal Lands**
B	**Project Management**	• **4% Default Value** • **3% US Public and Tribal Lands**
C	**Social/Policy**	• **2% Default Value** • **5% if project is located outside of the US** • **3% if project is located outside of the US and demonstrates community engagements through ACR-approved mechanism**
D	**Conservation Easement Deduction**	• **-2% Default value** • **-3% if there is regular onsite monitoring of activities related to carbon-specific conservation activities**

2. Natural Disaster Risks: Select one value from each risk category that applies:

E	**Fire**	• **8% if project is located in an area where fire greater than 1000 acres has occurred within 30 mile radius of project area in prior 12 months** • **4% if project is located in high fire risk region** • **2% if project is located in low fire risk region (verifiable evidence must be provided)** • **1% for agriculture and grassland projects only**
F	**Diseases and Pests**	• **8% if epidemic disease or infestation is present within project area, or within 30 mile radius of project area** • **4% Default Value**
G	**Levee Failure and Water Table Changes**	• **2% Default for all wetland projects (and for forest projects where more than 60% of the project area is a forested wetland)**
H	**Other Natural Disaster Events**	• **2% Default Value for all sequestration projects**

Calculated Risk Score:

1. *Section 1 (A + B + C + D) + Section 2 (E + F + G + H) = Total Risk score %*

2. Section 1 (4 + 4 + 2 + 0) + Section 2 (2[3] + 4[4] + 0 + 2) = 18%

The Minimum Buffer Percentage for the project is 18%, and the projected Buffer Contribution amount for the initial 20-year crediting period is **127,180** mt CO2e.

[3] https://www.firelab.org/project/wildfire-hazard-potential and Wildfire Map in Appendix C. Project Maps.
[4] https://www.fs.fed.us/foresthealth/applied-sciences/mapping-reporting/national-risk-maps.shtml

C.
ADDITIONALITY

C1. REGULATORY SURPLUS TEST

Relevant laws, regulations, statutes, legal rulings, and other regulatory frameworks that affect the project and baseline activities:

National laws, regulations, and policies:

- Clean Water Act
- Endangered Species Act
- National Environmental Policy Act
- National Wild and Scenic Rivers Act

State and local laws (Maine and New Hampshire):

- Forest Practices Act and Best Management Practices for Maine
- Timber Harvesting Laws and Best Management Practices for New Hampshire

None of the above or any other existing law, regulation, statute, legal ruling, or other regulatory framework in effect as of the project Start Date of October 8th, 2021 effectively requires the project activity and its associated GHG emissions reductions/removal enhancements. Therefore, the project passes the Regulatory Surplus test. Further detail on these laws and regulations and how they were incorporated as constraints on the modeled baseline scenario can be found in E1. BASELINE.

C2. COMMON PRACTICE TEST

The project is located in Southwestern Maine and Northeastern New Hampshire. Demand for wood, including sawtimber and pulpwood, from mills throughout the Northeast drives investment in timberland, with industrial forestland owners seeking to maximize the NPV of their investments through intensive management practices. Investment return requirements can lead to significantly higher harvest levels and were the project not implemented the intensive management and resulting lower onsite carbon stocks associated with that level of harvest activity could very well occur within the project area. As described in A6. PROJECT ACTION the project will exceed common practice in the region.

C3. IMPLEMENTATION BARRIERS TEST

The project activity faces a financial barrier. The net present value of the baseline scenario and its intensive management is calculated in the 'NPV_Model' tab of the 'ACR735 GHGPP Calculations' workbook. Revenue generated by the carbon project will always fall short of the NPV-maximizing baseline scenario. However, the carbon revenue will be a key driver of the financial viability of the project's action and the landowner's long-term sustainability goals.

C4. PERFORMANCE STANDARD TEST

Not applicable.

D.
MONITORING PLAN

D1. MONITORED DATA AND PARAMETERS

The following parameters, specified in the Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal U.S. Forestlands v1.3, will be monitored. More information on specifications for data or parameters monitored through field inventories is available in Appendix B. Inventory Specifications. Additional information on updating and archiving of these parameters for annual updates to forest carbon stocks in in section D.2. Personnel involved in monitoring the project include Ernest Bowling and his staff at Sewall Forestry Consulting, with remote sensing support from Adam Trenholm and staff at Finite Carbon. The required re-inventory of data or parameters below will be conducted by Sewall Forestry or another inventory contractor every 10 years or less, except for carbon in harvested wood products, which will be quantified from scaled volumes by species and product class on an annual basis in years when timber harvesting occurs.

Data or Parameter Monitored	Sample Plot Area
Unit of Measurement	Acres (fixed)
Description	1/20th acre (26.3-foot radius) fixed radius sample plot for all stems 5.0 inches DBH and larger, 1/150th acre (9.6-foot radius) fixed radius plot for all stems equal to or greater than 1.0 inch DBH and less than 5.0 DBH
Data Source	Appendix B. Inventory Specifications.
Measurement Methodology	Following inventory specifications detailed in Appendix B. Inventory Specifications, the inventory employs nested fixed-radius plots. Plot centers are permanently monumented in the field.
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Reported in project monitoring reports.
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Diameter at breast height (DBH)
Unit of Measurement	Inches (to 1/10th an inch)
Description	Tree diameter measured 4.5 feet above ground
Data Source	Field measurement
Measurement Methodology	Measured with a diameter tape
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Total height (THt)
Unit of Measurement	Feet
Description	Total height of tree
Data Source	Field measurement
Measurement Methodology	Measured with laser hypsometer
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Species
Unit of Measurement	FIA species code
Description	Species of tree
Data Source	Field measurement
Measurement Methodology	Recorded in accordance with the USDA FS FIA numerical three-digit species codes for all live and dead stems.
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Live/Dead status
Unit of Measurement	N/A
Description	Live or dead
Data Source	Field measurement
Measurement Methodology	Recorded for every tallied dead tree.
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Decay class
Unit of Measurement	Classes 1 – 4

Description	Decomposition class of the dead tree, following the four decomposition classes in the IFM Methodology.
Data Source	Field measurement
Measurement Methodology	Qualitative assessment of dead tree into 1 of 4 decay classes based on class descriptions.
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Defect
Unit of Measurement	Percent missing
Description	Assessment of missing biomass.
Data Source	Field measurement
Measurement Methodology	See 'Soundness Deduction' in 'Inventory Sample Design.'
Data Uncertainty	None
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Live Carbon ($C_{P,TREE,t}$)
Unit of Measurement	Metric tons CO_2
Description	Carbon stored in above and below ground live trees at the beginning of the year *t*
Data Source	Forest inventory
Measurement Methodology	Consistent with field measurement protocols specified in Appendix B. Inventory Specifications and quantification methods specified in Woodall et al (2011), further described in E1.3.6.1 of the GHG Project Plan.
Data Uncertainty	To be calculated as the mean +/- 90% confidence interval
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Tree – Dead Carbon ($C_{P,DEAD,t}$)
Unit of Measurement	Metric tons CO_2
Description	Carbon stock stored in dead wood at the beginning of the year *t*
Data Source	Forest inventory
Measurement Methodology	Consistent with field measurement protocols specified in Appendix B. Inventory Specifications and quantification methods specified in Woodall et al (2011), further described in E1.3.6.1 of the GHG Project Plan.
Data Uncertainty	To be calculated as the mean +/- 90% confidence interval
Monitoring Frequency	Re-measured every 10 years or less.
Reporting Procedure	Hand-held data recorder and/or cruise tally sheet
QA/QC Procedure	Consistent with procedures described in Appendix B. Inventory Specifications.
Notes	

Data or Parameter Monitored	Harvested Wood Products (CP,HWP,t)
Unit of Measurement	Metric tons CO_2
Description	Carbon remaining stored in wood products 100 years after harvest for the project in year t.
Data Source	Monitored from recorded harvest volumes.
Measurement Methodology	Scaled mill receipts.
Data Uncertainty	None
Monitoring Frequency	Annually
Reporting Procedure	Total volume harvested by species group and product class summed for the reporting period.
QA/QC Procedure	N/A
Notes	

Data or Parameter Monitored	Project Area (A)
Unit of Measurement	Acres
Description	Area of forest carbon project
Data Source	GIS shapefile
Measurement Methodology	Stratified shapefile
Data Uncertainty	None
Monitoring Frequency	Every 10 years or less, coinciding with inventory update. Annual updates as needed, see D2. MONITORING AND UPDATING FOREST CARBON STOCKS AND ENVIRONMENTAL IMPACTS
Reporting Procedure	Handheld GPS, ArcGIS
QA/QC Procedure	Boundary checks with handheld GPS, review of publicly available parcel boundary information.
Notes	

Data or Parameter Monitored	Time (T)
Unit of Measurement	Year
Description	Number of years between monitoring time t and t1 (T = t2 – t1)
Data Source	Monitoring repots
Measurement Methodology	N/A
Data Uncertainty	N/A
Monitoring Frequency	Yearly
Reporting Procedure	N/A
QA/QC Procedure	N/A
Notes	

E.
QUANTIFICATION

E1. BASELINE

E.1.1 Inventory

The carbon inventory of the project area was conducted in November 2021. The inventory employed a sample of 126 nested, fixed-radius circular plots installed in a random distribution across the project area. The nested plots consist of a 1/20th acre (26.3-foot radius) fixed radius sample plot for all stems 5.0 inches DBH and larger and a 1/150th acre (9.6 foot radius) fixed radius plot for all stems equal to or greater than 1.0 inch DBH and less than 5.0 DBH. Complete inventory specifications are documented in Appendix B. Inventory Specifications.

E.1.2 Stratification

The goal of the project area stratification was to provide an unbiased stratification of the project area's vegetative communities and to remove non-forested areas. Finite Carbon used a combination of forest owner data, on-the-ground observations, historical forest typing data, imagery, and experience with regional forest cover types.

Prior to sampling the project area, Finite Carbon assessed the overall quality and integrity of the mapped boundaries and underlying spatial data. Ancillary spatial data was taken from a variety of sources including publicly available data, landowner shapefiles, and files created from site visit field work. In all cases, GIS shapefiles are projected to the proper coordinate system, checked against publicly available shapefiles for ownership and boundary issues, ground-truthed using GPS and other field equipment, and then stored in geodatabases to ensure compatibility with outside data and data integrity. Tools used include ESRI ArcMap and Geodatabase, GPS devices with at least 3 to 5 meter accuracy, and orthorectified aerial photography.

Following sampling of the project area, the project area was post-stratified for purposes of defining biologically consistent strata which met targeted levels of statistical precision. Supported by plot data collected in the inventory, stratification of the defined project area utilized stand outlines based on general forest types that were either dominated by northern hardwood (maple, beech, oak, etc.), spruce-fir, pine-hemlock, and aspen-birch. Physiognomic characteristics observed from aerial imagery at a typed plot's location was also used to delineate unique stratum polygons and define strata polygons in areas proximal to the observed plot conditions. Multiple years of imagery contribute additional physiognomic information when assigning delineated areas to a stratum. The process was completed using publicly available and privately acquired orthorectified aerial imagery at "eye elevation" or approximately 3,500 feet.

The final inventory strata and acreages are shown below. The project employs the same stratification for the baseline and with-project scenarios.

Table E1.2.1 Inventory Strata

Inventory Strata Name	Description	Project Acreage
AB	Aspen-birch dominant	135.6
HP	Hemlock-pine dominant	2,980.1
NH	Northern hardwood (oak, maple, beech dominant)	4,780.2
SF	Spruce-fir dominant	672.4

E.1.3 Baseline Data Creation

E.1.3.1 Data Management and Analytical Systems

Once field measurements have been collected, the raw inventory data will be compiled by the inventory contractor. A database is then transferred to Finite Carbon in an MS Excel worksheet and/or MS Access database. The database contains multiple tables with the plot and individual tree measurements recorded by the cruisers. After receiving the data, Finite Carbon reviews it and executes a quality control/assurance process for validation. Keys are also setup to standardize relations between spatial and tabular data. Once the raw data has been assured for quality, it is formatted into a MS Access database for input to the Forest Vegetation Simulator (see below) using Finite Carbon's proprietary *Carbon Modules*. The Carbon Modules are a set of proprietary MS Access relational databases setup to process and compile raw inventory data, prepare FVS input tables, and calculate carbon stocks from FVS Output. The carbon modules are built upon a series of queries that select data and perform the calculations necessary to summarize onsite and harvested carbon stocks.

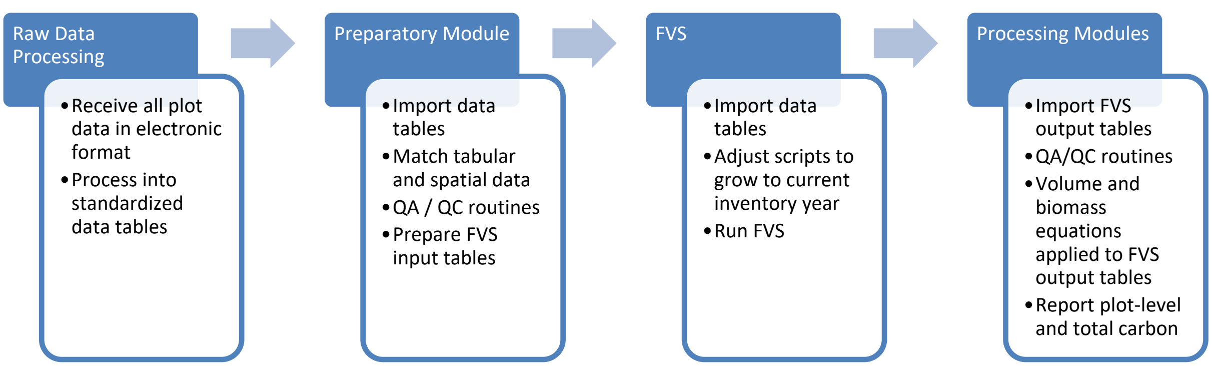


Figure E1.3.1. Schematic of Carbon Modules and Data Processing Flow

E1.3.2 Forest Vegetation Simulator (FVS)

Finite Carbon uses the Forest Vegetation Simulator (FVS) model to accept processed inventory data from the preparatory Carbon Module and to output tree lists for the current inventory year so that carbon can be calculated in downstream processing Carbon Modules. The growth functions of FVS are applied, if necessary, to grow carbon stocks forward to the current reporting period end date.

The Forest Vegetation Simulator (FVS) is a family of forest growth simulation models supported and maintained by a special unit of the USDA Forest Service (www.fs.fed.us/fmsc/fvs/). Since its initial

development in 1973, it has become a system of highly integrated analytical tools. These tools are based upon a body of scientific knowledge developed from decades of natural resources research.

The FVS is an individual-tree, distance-independent growth and yield model (Dixon 2002). It has been calibrated for specific geographic areas (variants) of the United States. FVS can simulate a wide range of silvicultural treatments for most major forest tree species, forest types, and stand conditions. The Northeastern (NE) Variant has been used for this project (Keyser 2008).

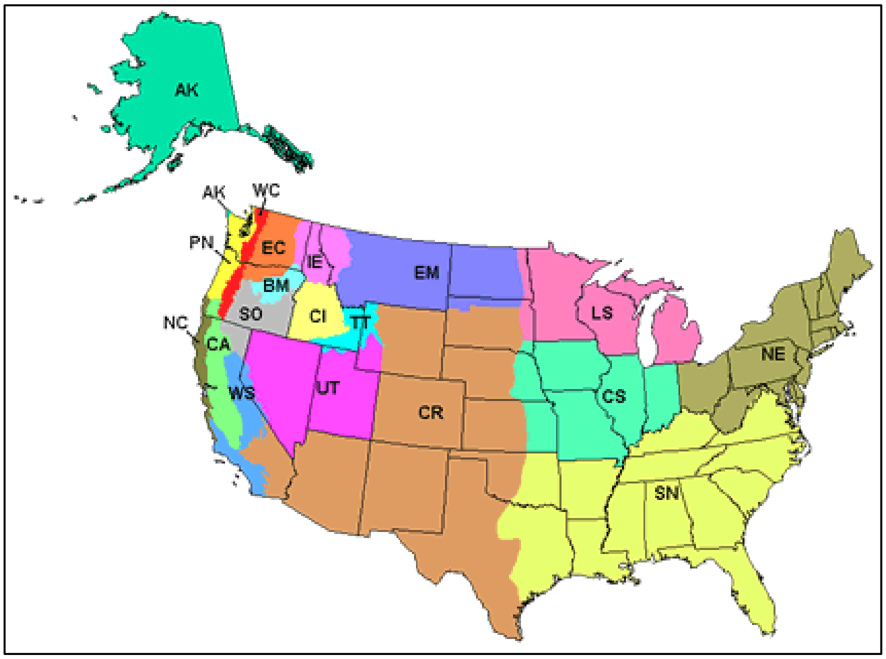


Figure 1. FVS Variants

The following summarizes basic FVS operation and the major model execution steps. Specific operation details will vary for different variants.

1. Process keywords and input data - FVS begins by reading keywords to establish location, environment, and stand parameters; then reads the tree record file.

2. Compute initial stand characteristics - FVS computes stand characteristics for the initial year (cycle 0). This is typically the inventory date or the stand regeneration date. Input tree records with missing heights or crown ratios have these dubbed in.

3. Backdate densities and compute calibration statistics - If sufficient large tree diameter increment data is contained in the input tree data (and/or small tree height increment data), FVS back-dates the stand one default cycle length. FVS then “grows” the stand back to the inventory date, compares the values from the actual inventory date with simulated values, and computes scale factor adjustments to account for differences in actual and model values.

4. Check event monitor (pre-treatment) - FVS continues with the steps it repeats every cycle. FVS checks the Event Monitor keywords and functions to see if the user scheduled any activities

based on existing stand conditions at the start of the cycle. Event Monitor capabilities are powerful and very useful for modeling situations and creating variables not covered in standard FVS output. Crookston (1990) describes Event Monitor functions and processes along with several good examples.

5. Perform treatment - Almost any silvicultural operation imaginable can be structured using one or more treatment keywords in a direct or conditional (If..Then) context.

6. Check event monitor (post-treatment) - FVS Event Monitor checks for conditions and scheduled operations that are based on post-treatment activity conditions within the same cycle.

7. Grow large trees - If “large” trees exist in the tree-list, FVS estimates their new diameter (first) and height (second) one growth cycle into the future. The user can specify a different time interval length.

8. Grow small trees - FVS estimates small tree height (first) and diameter (second) one growth cycle into the future. FVS uses a weighting procedure to compute tree height increment to obtain a smooth height-growth transition from small to large tree models.

9. Mortality - Following growth estimation, FVS estimates mortality based on individual tree variables such as diameter and crown ratio, and on stand variables such as maximum stand density index or basal area (“BA”).

10. Insect and disease impacts - If the variant has available extensions to cover specific disease or insect agents, and if the user calls for these, FVS estimates and incorporates these effects.

11. Regeneration - FVS adds new seedlings to FVS tree-lists in the regeneration step. Some FVS variants have natural regeneration routines, but most variants depend on the user to specify the species and number of trees to plant. Some variants have a stump sprouting algorithm, whereby certain species will sprout after a harvest.

12. Crown change - FVS estimates crown ratio change for all trees based on stand density and the trees position in the density distribution.

13. Update stand characteristics and compute volume - After projecting the stand for the growth cycle, FVS computes, summarizes, and records the stand attributes, including volume. Volume is computed using corporate equations from the National Volume Estimation Library.

14. Test for more cycles to be projected - FVS repeats the sequence from the initial "Check Event Monitor", per Figure 2, to this point for each cycle until the specified number of cycles is completed.

15. Final FVS Output file reports and post-processor files - After FVS completes the scheduled cycles, it prints final output file reports and generates files specified by the user for running post-processors, including SVS.

The FVS growth model is used in this project to estimate growth and mortality based on field measurements and management activities over time. Finite Carbon uses the Database Extension of FVS (Crookston 2003) to read FVS input database tables created by the carbon modules into the FVS program.

E1.3.3 Data and FVS Settings

E1.3.3.1 FVS Input Data:

The FVS input database is comprised of three tables: FVS_GroupAddFilesAndKeywords; FVS_StandInit; and FVS_TreeInit.

Table E1.3.1 FVS Input Data

Table Name	Field Name	Description
FVS_GroupAddFilesAndKeywords	Groups	Used to assign keywords to all strata or a specific stratum
	AddFiles	Not used
	FVSKeywords	A list of FVS Keywords which define the FVS run (described further below)
FVS_StandInit	Stand_CN	Stand Control Number: Used for the FVS yield curve ID number
	Stand_ID	Stratum
	Variant	"NE" Northeastern Variant
	Inv_Year	"2021" - The inventory year of the plots associated with the Stand_CN.
	Location	"922" – White Mountain National Forest. Indicates the closest National Forest Region and Forest Number to the project area.
	ECOREGION	Not used
	PV_Code	Not used
	Basal_Area_Factor	"-20" - The inverse of the fixed plot size in acres (1/20 acre) using negative value to indicate fixed radius rather than Basal Area Factor.
	Inv_Plot_Size	"150" - The inverse of the fixed plot size in acres (1/150 acre fixed radius plot) – used for subplots, in this case to measure trees less than 5.0" DBH.
	Brk_DBH	"5.0" – indicates that all tree records >= 5.0" DBH are processed using the Basal Area Factor (1/20-acre plot in this design), all trees less than 5.0" DBH are processed using the subplot.
	Num_Plots	Total number of plots associated with Stand_CN.
	NonStk_Plots	Number of non-stockable plots associated with Stand_CN (not used because total number of plots used).
	Site_Species	Not used. See section "Site Index, Site Class, and Growth Determination" below for further details.
	Site_Index	Not used. See section "Site Index, Site Class, and Growth Determination" below for further details.
FVS_TreeInit	Stand_CN	Stand Control Number: Used for the FVS yield curve ID number
	Stand_ID	Stratum
	Tree_ID	Tree identification code for plot

	Plot_ID	Plot identification code
	Tree_Count	The number of trees on plot with the exact same measurements (always 1, no repetition counts used).
	History	Tree history code, e.g. alive, recent mortality, "older" mortality
	Species	Tree species
	DBH	Diameter at breast height
	Ht	Total height in feet
	HtTopK	Height to top kill in feet
	Damage1	"25" - Percent defect of tree's merchantable cubic foot volume
	Severity1	"1-99" (99 = 100%) – percent defect
	Damage 2	"55" – Custom code
	Severity 2	Product code (if dead tree then dead tree decay class)
	TreeValue	Tree value class, in this case it is used to distinguish live cull trees (using a code value of "3"). "8" is used to indicate a no-tally plot. All other values indicate a live tree or dead tree, e.g. "1".

E1.3.3.2 FVS Settings

The FVS model has many program options to control the inputs and variables which affect growth and yield. These options are typically set using "FVS Keywords." They are programmed in the FVS input tables or selected in Suppose[5]. The following keywords are used for this project:

NOTRIPLE (No tripling) – Random effects are incorporated in the Forest Vegetation Simulator in the manner originally described by Stage (1973), and subsequently updated to reflect changes in program control variables. The program assigns all random effects to the distribution of errors associated with the prediction of the logarithm of basal area increment. Basal area increment was selected to reflect the stochastic variation because the effects of differing diameter growth rates extend in highly nonlinear ways through most of the remaining components of the model. This distribution of errors is assumed to be Normal, with a mean of zero. The variance of this Normal distribution is computed as a weighted average of two estimates; the first estimate is derived from the regression analysis that developed the prediction function, and the second estimate is the standard deviation of the differences between the recorded growth for the sample trees in the population (transformed to the logarithm of basal area increment) and their corresponding regression estimates. The weights assigned to these two estimates are (1) the number of observations by species and/or habitat type in the database for the model for the prior component of error, and (2) the number of growth-sample trees in the stand for the second component of error (Mehta 1972).

The random component of change in tree diameter is treated in two ways, depending on how many tree records make up the stand being projected. When there are many tree records, the effects of any one random deviation on the growth rate of one tree would be blended with many other trees, and the

[5] Suppose v2.02 is the FVS graphic user interface (GUI).

stand totals should be quite stable estimates. Accordingly, a random deviate from the specified distribution is added to the logarithm of basal area increment.

When relatively few sample trees represent the stand, however, a different strategy is used. In order to increase the number of replications of the random effects, two additional records augment each tree record. These new records duplicate all characteristics of the tree except the predicted change in diameter and the number of trees per acre represented by the source tree record. The trees per acre value of the original tree record are reduced to 60 percent of its current value. The two new records are given 15 and 25 percent of the original value; thus, the three records together still represent the same number of trees per acre. This process is known as tripling.

Because each stratum in the project area contains an adequate number of tree observations, tripling is not used in this modeling; it is turned off with the NOTRIPLE keyword.

SPGROUP - Defines a group of species that can be referenced by a single name, or FVS sequence number, and will be treated as a group in management actions or event monitor functions. Users may define up to 10 species groups with each group containing up to 50 species codes. If the species group name is entered in the species field of a keyword, the keyword action will apply to all species in the group. One or more supplemental records are required that contain the FVS species codes or FVS species sequence numbers.

The SPGROUP keyword was used to define the species group “CONIFER”, containing all coniferous species. This species group was used in the calculation of naturally seeding conifers following certain harvest events.

MINHARV (Minimum Harvest) - Specifies minimum acceptable harvest standards for board-foot volume, merchantable cubic-foot volume, basal area per acre, or total cubic foot volume. The accumulated removals across all thinnings in a cycle must exceed the standards for all the units of measure (fields 2, 3, 4, and 5), or none of the thinnings in that cycle will be implemented.

This keyword was used in thinning treatments to ensure that a silvicultural treatment (harvest) satisfies a minimum harvest level for financial and operational feasibility. The minimum harvest volume was set to 600 merchantable cubic feet per acre for all prescriptions and strata types based on Finite Carbon’s previous experience in similar forest types in the region.

THINABA (Thin from Above to Basal Area target)- Schedules a thinning from above to a basal-area-per-acre target. Only trees with DBH’s and heights within the user-defined ranges are considered for removal. The tree record with the largest diameter within the specified range is considered for removal first, and the proportion of that tree record specified in field 3 is removed. The tree record with the next largest diameter is considered next, then the next largest and so on until the residual basal area target is met or all records in the specified range have been considered. The residual target basal area is specified only for the user-defined range of DBH and height and does not represent the total residual unless the range of DBH’s and heights includes all trees in the stand.

The THINABA keyword was used to simulate heavy thins from above in upland stands. The target residual basal area was set to 30 square feet per acre, consistent with typical silvicultural practices in the state of Maine.

THINDBH (Thin from a DBH range) – Schedules a thinning from throughout a specified DBH range for any or all species to a basal area per acre or trees per acre target. If the target trees per acre or target basal area is nonzero, thinning occurs uniformly throughout the specified DBH range until the target is met (cutting efficiency is ignored). In other words, a calculated proportion of each of the eligible tree records is removed such that the target trees per acre or target basal area is exactly met. If both residual targets are 0 (zero), the cutting efficiency determines the proportion of trees represented by each eligible tree record that will be removed (residual targets are ignored). Only trees of the user-specified species that are within the user-defined DBH range are considered for removal. The residual target basal area per acre or trees per acre is specified only for that species and DBH range and does not represent the total residual unless the DBH range includes all trees of all species in the stand.

The THINDBH keyword was used to simulate light canopy thins, primarily in SMZ buffer areas, although this prescription was also allowed in upland stands. The residual target basal area was set to 60 square feet per acre for stems measuring 4.5 inches DBH and above.

ESTAB (Establishment Model) – signifies the beginning of keywords for the Regeneration Establishment extension. The ESTAB keyword sequence must be terminated with an END keyword. All keywords between ESTAB and END are considered Establishment extension keywords.

Eastern FVS variants contain a partial establishment model which may be used to input regeneration and ingrowth into simulations. Sprouts are automatically added to the simulation following harvest for sprouting hardwood species, which applies for all hardwood trees sampled in the inventory. Regeneration of conifer seedlings however must be simulated following the ESTAB keyword with additional keywords as described next.

NATURAL (Natural regeneration) – Specifies natural regeneration that will be added to the stand.

This keyword was used to simulate natural regeneration of conifer following thinning treatments based on FVS-predicted hardwood. Natural regeneration was invoked in the cycle immediately after the treatments occurred with a species-specific distribution in each stratum and with a specific total trees per acre for each treatment.

In all treatments, seedlings have an 100% expected survival rate, an average seedling age of 2 (default) in years for the year specified in Field 1, and a shade code of 0 (seedlings occur more uniformly on plots throughout the strata). The average seedling height was calculated automatically by FVS.

COMPUTE - allows the user to define variables expressed as mathematical expressions containing constants, Event Monitor variables, Event Monitor functions, and variables previously defined using the COMPUTE keyword. Variables are defined using mathematical equations in supplemental records, which are up to 80 characters long. The Event Monitor feature of FVS allows users to specify a set of

conditions that must occur, or thresholds that must be reached in order for FVS to simulate a management activity or set of management activities. The COMPUTE keyword is used to define variables that are evaluated by the Event Monitor to determine if necessary conditions or thresholds have been met.

The COMPUTE keyword was primarily used, in conjunction with FVS Keyword SPMCDBH to define the amount of naturally regenerating conifer seedlings following thinning harvests, depending on the amount of sprouting that FVS predicted.

IF-THEN-END IF - also known as scheduling by condition, the IF-THEN-END IF code block is used to execute FVS actions once certain conditions are met. The Event Monitor keyword sequence must begin with an IF keyword. The next record must be a condition statement that evaluates to true or false. The next record is a THEN keyword. The sequence ends with an ENDIF keyword. All keywords contained between the THEN and ENDIF keywords will be executed whenever the condition is true. The condition is checked every cycle, unless that cycle falls within the minimum waiting time since the last time the condition was true.

A record of how all keywords were used in the modeling can be found in the FVS input databases delivered as part of the baseline modeling package with this project.

NUMCYCLE - Specifies the number of cycles to run the projection. A cycle is the period of time for which tree characteristics are predicted, and for which inventories are reported (see TIMEINT).

TIMEINT - Specifies the length, in years, of any or all projection cycles. This keyword is used to ensure that an action can be implemented in the same year that it is scheduled rather than the FVS default, which is the first year of a cycle. The default projection cycle for the NE variant of FVS is 10 years. TIMEINT was used in conjunction with NUMCYCLE and IF-THEN-END IF code blocks to offer different timing possibilities of silvicultural actions throughout the 100-year planning horizon for each stand type. Having multiple prescriptions available for each stand in which different sequences and timing of harvest events and other silvicultural events occur ensures that property-level constraints, such as upper or lower limits on harvest volumes, can be met in the baseline planning model described below.

RESETAGE - Sets the stand age to zero to make FVS model output correspond to the actual age of the stand. Age is strictly for reporting purposes and has no effect on growth or survival prediction. Its only effect is on the calculation of mean annual increment. This keyword is useful when average stand age has changed due to thinnings and plantings.

This keyword was used to reset stand age after certain harvest types so that the timing of subsequent harvests could be calculated and controlled programmatically as necessary. A record of how all keywords were used in the modeling can be found in the FVS input databases delivered as part of the baseline modeling package with this project.

SITECODE - Sets species-specific site index values. If a SITECODE keyword is present, all species for which site index values were not explicitly set will be assigned site index values derived from the site index of

the specified site species. If no SITECODE keyword is present, default site index values are assigned. Site index can be described for the site species of an entire stand, which is equivalent to entering a species code in the "Site_Species" field in the FVS_StandInit table, and for all other species in the stand. This keyword was used to assign site index values derived from the site index estimation procedures described below.

A record of how all keywords were used in the modeling can be found in the FVS input databases.

E1.3.4 Site Index and Growth Determination

The Yield - Soils Overlay method determines the potential productivity of each Assessment Area (MAI in Cubic Feet per Acre per Year) within the Project Area from soil survey data obtained from the USDA Natural Resources Conservation Service (NRCS). These results are then used to estimate Site Index values to calibrate growth rates within FVS.

The NRCS provides soil survey data at no cost from their *Web Soil Survey (WSS)* platform for almost all the contiguous United States. The data can be delivered in SSURGO format, which has spatial and tabular components allowing users to group and report soils data for a focus area.

The steps to perform this method using NRCS SSURGO soils overlay data are as follows:

1. Download soil dataset and coverage for Project Area (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx).
2. Use ArcGIS Overlay Identity Analysis Tool to attribute Project Area with soil survey Mapping Unit Key (mukey).
3. Relate soil mapping units with soil series components.
4. Relate soil series components with site index values (Carmean et al 1989) and determine the average site index for all suggested species.
5. Aggregate species site index by strata and soil mapping unit weighted by component representative percent (i.e. weighted average method).

The results of the site index analysis are shown below. The site species for each stratum was determined by ranking the basal area percentage of each species.

Table E1.3.2 Site Index by Strata

Inventory Strata	Species	Acre-Weighted Average Site Index	FVS Code	Site Species
AB	American beech	60.0	AB	Y
AB	northern red oak	68.0	RO	
AB	red maple	64.3	RM	
AB	red pine	60.8	RN	
AB	tamarack	64.4	TA	
HP	American beech	60.0	AB	

HP	black spruce	21.6	BS	
HP	northern red oak	71.0	RO	
HP	pitch pine	60.0	PP	
HP	red maple	63.5	RM	Y
HP	red pine	59.9	RN	
HP	tamarack	64.1	TA	
NH	American beech	60.1	AB	
NH	black spruce	36.6	BS	
NH	northern red oak	68.4	RO	Y
NH	red maple	64.8	RM	
NH	red pine	60.3	RN	
NH	tamarack	65.0	TA	
SF	American beech	60.0	AB	
SF	northern red oak	59.6	RO	Y
SF	red pine	60.7	RN	
SF	tamarack	66.0	TA	

E1.3.5 Annual Growth and the Initial Project Inventory

The initial project inventory was conducted in the field during November 2021, assumed to effectively represent growth through the end of growing season 2021. The initial reporting period start date is October 8, 2021. According to growing season data compiled online by the Farmer's Almanac for Bethel, ME (accessed their website in early June), the nearest reported locale to the project site, the average growing season (as indicated by the last freeze of the year) commences annually on May 11[6] and averages 138 days in length.

Average annual growth was modeled by growing the inventory forward ten years (the default cycle length for the NE variant) and determining the annual diameter and height increment for each individual tree record. Plot-level carbon results representing the start of RP1 were calculated from the inventory tree list, as tree measurements in November reflected the complete 2021 growing season.

E1.3.6 Estimation of Initial Carbon Stocks

E1.3.6.1 Carbon quantification methodology

The quantification methodology of Woodall et al (2011) was used to quantify above ground and below ground biomass for live trees. Missing bole biomass due to defect was applied to trees with recorded defect as a percentage of total bole volume.

For standing dead trees, the decomposition class of each dead tree was categorized into one of four decomposition classes:

1. Tree with branches and twigs that resembles a live tree (except for leaves)

[6] https://www.almanac.com/gardening/frostdates/ME/Bethel

2. Tree with no twigs but with persistent small and large branches
3. Tree with large branches only
4. Bole only, no branches

Biomass was estimated following the Woodall et al (2011) methodology as per live trees except for decomposition class 4. For decomposition class 4, the biomass estimate was limited to the main stem of the tree. For standing dead trees with missing tops, the top and branch biomass were assumed to be zero. In addition to the application of recorded defect as per the live trees, further reductions in biomass by dead wood density classes were taken for dead trees as follows: Class 1 – 97% of live tree biomass; Class 2 – 95% of live tree biomass; Class 3 – 90% of live tree biomass, and Class 4 – 80% of live tree biomass.

Total project carbon (in metric tons CO2) was calculated by summing the biomass of each stratum for the project area and converting biomass to carbon by multiplying by 0.5, kilograms to metric tons by dividing by 1000, and finally carbon to CO2 by multiplying by 3.664.

E.1.3.6.2 Estimation of project carbon stocks

The initial and end-of-reporting period carbon stocks for this project are shown below.

Table E1.3.4 Reporting Period 1 Carbon Stocks

Strata	Acres	Live Above Ground CO2e per acre	Live Below Ground CO2e per acre	Standing Dead CO2e per acre	Total Onsite CO2e per acre	Total Onsite Carbon Stocks, mtCO2e
AB	135.6	21.19	4.44	0.19	25.82	3,503
HP	2,980.1	99.48	21.81	2.73	124.02	369,589
NH	4,780.2	90.18	17.93	2.06	110.17	526,614
SF	672.4	78.32	17.56	4.89	100.78	67,764
Totals:	**8,568.3**	**91.39**	**19.04**	**2.48**	**112.91**	**967,469**

E.1.3.7 Determining the Baseline

Per the ACR IFM protocol, the baseline represents the theoretical maximum net present value (NPV) that would be obtained from harvesting all available timber products existing on the subject property pursuant to applicable operational and regulatory constraints. Detailed below are the steps we used to quantify the timber revenues and associated expenses required for the NPV model.

E.1.3.7.1 Harvest Prescriptions

We utilized the USFS FVS growth and yield program to establish yield estimates for each applicable harvest method within each strata across the subject property. Input data, settings, and keywords used in the simulation of the harvest prescriptions have been described previously in section E.1.2.3.

Two essential harvest prescriptions / silvicultural regimes were simulated.

Heavy Thin: The "Heavy Thin" regime simulates a value-extracting removal of merchantable overstory trees to a residual target of 30 square feet of basal area. The thinning is specified as a thin-from-above treatment where the largest diameter classes are harvested first until the target BA is met. The stand is allowed to regenerate naturally and grow until the next overstory tree removal. The treatment does not discriminate against any particular species, so trees retained at harvest will maintain relatively the same species composition as the before treatment species composition. A stand was eligible for this type of treatment if removable harvest volume was at least 600 cubic feet per acre. Hardwood regeneration was simulated with natural sprouting in the model. Advanced regeneration from conifer species in the softwood strata was simulated in FVS. For more information about how conifer regeneration was simulated see the 'FVS Settings' section of this appendix.

This treatment type was only applicable for unencumbered (non – SMZ) upland stands.

Light Thin: A "Light Thin" was defined as a thinning prescription designed to simulate removal of merchantable trees in areas where a heavy thin was not applicable, primarily in riparian (Stream Management Zone) areas. A residual basal area of 60 square feet per acre was specified to adhere to best management practices. The treatment does not discriminate against any species, so trees retained at harvest will maintain relatively the same species composition as the before treatment species composition. A stand was eligible for this type of cutting if the harvest volume was at least 600 cubic feet per acre.

This treatment type was designed primarily for SMZ buffer areas but could be utilized in upland stands as well.

E1.3.8 Timber pricing

To formulate estimates of timber revenues associated with each merchandized product, we obtained recent timber price data from relevant state and county stumpage rate reports. Price data was then formatted to approximate representative stumpage values for each timber product.

E1.3.9 Cost assumptions

As part of the NPV optimization, relevant management and administrative costs were also included in the cash flow formulation. Variable and fixed costs associated with timber harvesting and property ownership, such as timber marking, road maintenance, and property taxes, were based on averages from Finite Carbon's experience in the region.

E1.3.10 Legal and market constraints

Model constraints were employed in the NPV optimization. Areas designated as SMZs were buffered in accordance with State of Maine Best Management Practices, which specifies widths of 75 feet for

streams and 250 feet for lakes, ponds, rivers, and non-forested wetlands. Management activities within the SMZ buffer areas were restricted to the 'Light Thin' prescription described above in E.1.3.7.1 Harvest Prescriptions. Merchantable harvest volume constraints, where total harvest volumes over the first 10 periods were kept within the bounds of market capacity, and also ensuring that volumes do not dramatically vary year-over-year in pursuit of NPV maximization, were included in the model.

E1.3.11 Maximizing NPV of timber harvests in baseline

FVS and the carbon modules were used to create yield tables representing a variety of 100-year harvest prescriptions / silvicultural regimes for each of the project strata. Over 40 regimes consisting of 100-year FVS simulations were run, and their FVS Outputs processed through the modules to create a series of yield curves based on the timing options specified by the FVS Keywords used to simulate each regime. These yield curves were then loaded into a proprietary Excel workbook in which the yield curves are interpolated to provide annual values of key carbon metrics. The final, annualized set of yield curves are next imported into Remsoft's Woodstock planning model to evaluate and allocate acres to each FVS yield table to help determine a final baseline harvest schedule that maximizes NPV while complying with all relevant legal constraints and operational considerations. Combining inputs for yields, economic metrics, and constraints, Woodstock uses linear programming, a forest industry standard for solving resource allocation problems, to find the optimal set of harvest prescriptions over the 100-year timeframe to maximize NPV. Baseline modeling assumes a real discount rate of 4% per ACR IFM protocol for industrial timberland owners. The results of this solution process are found in on the 'NPV_Model' tab of the 'Calculations' spreadsheet

Within the model, as typical with most harvest optimization exercises, the underlying preference was to first harvest stands exhibiting ages beyond the typical rotation age. Embedded in the logic of NPV-maximization is the "opportunity cost" of not harvesting low-growth stands that have reached or surpassed the age of financial maturity, thus inciting the model to select such stands for harvest first in favor of retaining younger, more vigorously growing stands. Harvest volume and acreage constraints were especially "binding" in the early years of the model given the higher rates of harvest activity.

E1.3.12 Harvested wood products

Long-term carbon storage in harvested wood products (HWP) were calculated in accordance with ACR IFM protocol section 3.2. The following steps were used:

Step 1:
HWP volumes were converted to CO2, without bark. Product classes included hardwood pulpwood, hardwood sawtimber, softwood pulpwood, and softwood sawtimber.

Step 2:
HWP carbon equivalents were multiplied against the associated mill efficiency coefficients, in this case the Northeastern region, as specified in the "Regional Mill Efficiency Data" database.

Table E1.3.5 USFS Mill Efficiency Coefficients, Northeast Region

Mill Efficiency: Northeast

Species	Product	Coefficient
Hardwood	Saw Log	0.614
Hardwood	Pulpwood	0.650
Softwood	Saw Log	0.569
Softwood	Pulpwood	0.513

Step 3:

Adjusted HWP carbon equivalents were then divided across the applicable Wood Product Class proportions per the most recently available ARB Assessment Area data file. An area-weighted average harvested wood product percentage was calculated based on the proportion of the project within two different supersections: White Mountains (37.28% of project area) and Lower New England – Northern Appalachia (62.72% of project area).

Table E1.3.6 Wood Product Class Proportions, White Mountains and Lower New England – Northern Appalachia Supersections Area-Weighted Averages

Wood Product Class	Harvest Wood Product %
Softwood Lumber	29.4%
Hardwood Lumber	22.6%
Softwood Plywood	0.3%
OSB	0.0%
Non Structural Panels	8.0%
Misc. Products	0.4%
Paper	39.4%

Step 4:

Wood product classes were then multiplied against the applicable 100-year storage factors for in-use products and landfill portions, per ACR IFM protocol.

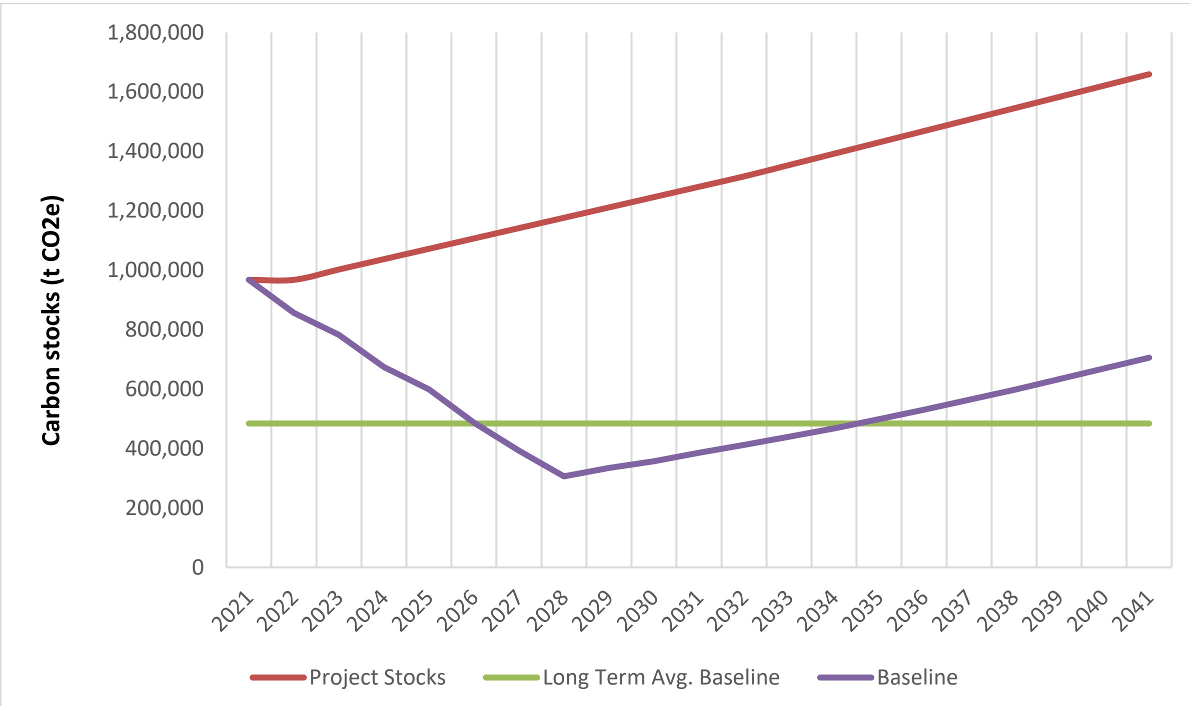
Table E1.3.7 Wood Product 100-year Storage Factors

Wood Product Class	100-year storage factors	
	In-Use	Landfills
Softwood Lumber	0.234	0.405
Hardwood Lumber	0.064	0.49
Softwood Plywood	0.245	0.4
OSB	0.349	0.347
Non Structural Panels	0.138	0.454

Misc. Products	0.003	0.518
Paper	0	0.151

Step 5:
Long-term carbon storage from both in-use and landfill portions were combined for all harvest activities in the model within a given year to formulate the total stored CO2e after 100 years from when harvesting occurred.

E1.3.13 Graph of baseline carbon stocks for first crediting period



E2. PROJECT SCENARIO

The actual project scenario is measured through future inventories over the course of the project lifetime. We produce an ex-ante projection of the project scenario assuming the landowner will conduct regular timber harvests over the next 20 years (A6. PROJECT ACTION). These calculations are detailed in the 'HWP_PRJ_Calcs' tab in the 'ACR735 GHGPP Calculations' workbook.

The quantification methodology follows the same approach described for the relevant carbon pools in the Baseline section above.

E3. LEAKAGE

No activity-shifting leakage is allowed by the ACR IFM methodology beyond de minimis levels. The project includes moderate levels of harvest activity projected beyond the first reporting period. Forest

management plans and historical records provided for verification demonstrate no deviation from management plans or from historical trends. All forested acres owned or under management control by the Project Proponent (Loon Echo Land Trust) and associated landowner (Mahoosuc Land Trust) are enrolled in the project, satisfying the requirement to demonstrate no leakage within their operations per ACR IFM v1.3 Errata and Clarification.

The quantification of leakage for the project is limited to market leakage. Where project activities decrease total wood products produced by the project relative to the baseline by 25% or more over the Crediting Period, the market leakage deduction is 40%.

E4. UNCERTAINTY

Project and baseline carbon stock uncertainty was calculated in accordance with equations 10 and 18 of the ACR IFM protocol. The associated metrics are included in the 'ERTs_UNC' tab of the 'ACR735 GHGPP Calculations' workbook. Per ACR IFM protocol, the error terms of standing live and dead CO2, e_{TREE} and $e_{DEAD,}$ are estimated from the most recent inventory data (i.e. the project inventory) for both the project and baseline carbon stocks. Given that log slash burning is not an applicable practice for the subject property, greenhouse gas emissions (GHG) are estimated to be zero in both the baseline and project scenarios. The total uncertainty of combined live and dead CO2e project stocks is 8.44%.

Table E4.1 Live and Dead mtCO2e Statistics

Strata	Plots	Avg Live CO2/acre	Std Dev Live CO2/acre	Avg Dead CO2/acre	Std Dev Dead CO2/acre	Coefficient of Variation of CO2/Acre	Coefficient of Variation of CO2/Acre
AB	4	108.11	62.78	2.06	5.25	58.07%	255.36%
HP	36	121.29	75.56	2.73	5.85	62.30%	214.19%
NH	76	25.63	7.17	0.19	0.39	27.97%	200.00%
SF	10	95.89	54.35	4.89	7.66	56.69%	156.59%

Table E4.2 Uncertainty Calculations, 90% Confidence Interval

$e_{TREE,\ t=1}$	8.59%
$e_{DEAD,\ t=1}$	34.55%
UNC	**8.44%**

E5. REDUCTIONS AND REMOVAL ENHANCEMENTS

Table E5.1 shows estimated net reductions and removal enhancements attributable to the project over the first 20-year crediting period (2021 - 2041). Annual project-level uncertainty remains below the 10% threshold required by the ACR protocol, therefore no uncertainty deduction was applied to the annual Emission Reduction Tons (ERTs) generated by the project. ERTs presented in Table E5.1 incorporate the assumed 40% market leakage.

Table E5.1 Estimate of Net ERTs by Year (Including Buffer)

Reporting Period	Year	Estimated GHG emissions reductions (mt CO2e)
1	2021	54,571
2	2022	53,068
3	2023	70,486
4	2024	53,919
5	2025	72,190
6	2026	17,345
7	2027	17,345
8	2028	17,345
9	2029	17,345
10	2030	17,345
11	2031	17,345
12	2032	19,010
13	2033	19,010
14	2034	19,010
15	2035	19,010
16	2036	19,010
17	2037	19,010
18	2038	19,010
19	2039	19,010
20	2040	19,010

E6. EX-ANTE ESTIMATION METHODS

Table E6.1 shows projected CO2e stocks under the project scenario described in Section E2. Project Scenario.

Table E6.1 Estimate of Ex-Ante Project Stocks

Year	Live Trees (mtCO2e per acre)	Standing Dead (mtCO2e per acre)	HWP (mtCO2e per acre)
2021	110.4	2.5	0.0
2022	114.1	2.9	0.4
2023	117.7	3.4	0.4
2024	121.3	3.8	0.4
2025	124.9	4.2	0.4
2026	128.6	4.7	0.4
2027	132.2	5.1	0.4
2028	135.8	5.5	0.4
2029	139.4	6.0	0.4
2030	143.1	6.4	0.4
2031	146.7	6.8	0.4
2032	149.9	8.1	0.4
2033	153.0	9.4	0.4
2034	156.2	10.7	0.4
2035	159.4	12.0	0.4
2036	162.6	13.3	0.4
2037	165.7	14.5	0.4
2038	168.9	15.8	0.4
2039	172.1	17.1	0.4
2040	175.3	18.4	0.4

F.
COMMUNITY & ENVIRONMENTAL IMPACTS

F1. NET POSITIVE IMPACTS

The environmental and community impacts of the Project Activity have been assessed in accordance with the ACR Standard. The five ACR requirements for environmental and community impact assessments are addressed below.

Net positive community and environmental impacts have been identified. See A6. Project Action for more information on past and current management of the project area. In addition to carbon sequestration, the sustainable management of the project area will provide additional benefits in the form of conservation of natural forest habitat, protection of plant and animal species, water quality protection, and the protection of soil resources from erosion and degradation. The project actions include deferred harvesting, lengthened rotations, timber stand improvement, retention of standing dead wood during timber harvests, and protection of riparian areas, wetlands, and significant natural communities. All of these actions have been shown to provide net positive benefits to local communities and the environment.

No negative community or environmental impacts are foreseen from the Project Proponent's commitment to long-term sustainable forest management. Environmental impacts are entirely positive. Any negative economic impact on communities from enrollment of 8,568.3 forested acres in an Improved Forest Management program is effectively de minimis, particularly given the size of the larger wood basket in which the project is located.

1. Overview of Project Activity and geographic location
See A5. BRIEF SUMMARY OF PROJECT and A4. LOCATION.

2. Applicable laws, regulations, rules, and procedures and the associated oversight institutions
See C1. REGULATORY SURPLUS TEST.

3. A description of the process to identify communities and other stakeholders affected by the project and, as applicable, the community consultation and communication plan
No formal stakeholder consultation was conducted prior to the commencement of project activities. The project area is privately held property, so no stakeholder consultation was required. If Project Proponent is contacted by any persons or entities regarding the project, Project Proponent will provide references to the publicly available documentation for the project.

4. An assessment of the project's environmental risks and impacts

Impact	Carbon Sequestration – Enhanced carbon sequestration from deferred harvesting and long-term sustainable forest management (SDG Goal 13, Climate Action)
Risk Category	Positive – The combination of management actions described above and in A6. Project Action will lead to increased carbon sequestration relative to business-as-usual management.

Measure(s) to avoid, reduce, mitigate, or compensate negative impacts	N/A
Monitoring Plan	See D. MONITORING PLAN for how biomass/onsite carbon stocks will be monitored for the project term.

Impact	Conservation of natural forest habitat; protection of plant and animal species (SDG Goal 15, Life on Land)
Risk Category	Positive - The combination of management actions described above and in A6. Project Action will protect forest habitat and species found in the project area. Important habitat components found on this forest include early successional habitat, hard and soft mast, seeps, standing dead trees (snags), coarse woody debris, deer winter areas, vernal pools. Maintaining these attributes is a part of the ongoing sustainable management of the property. Harvest deferrals and long-term sustainable management of the project area will create more late successional habitat, while future harvest activity will maintain areas of early successional habitat. Sensitive habitat and riparian areas will be protected.
Measure(s) to avoid, reduce, mitigate, or compensate negative impacts	N/A
Monitoring Plan	See D. MONITORING PLAN

Impact	Water quality protection (SDG Goal 6, Clean Water and Sanitation)
Risk Category	Positive - Water-quality degradation on managed timberlands is commonly the result of erosion and sedimentation from roads, skid trails, or landings. Maine has developed a set of management practices for maintaining water quality on logging jobs to protect the waters of the state from these risks. Forest management in the project area will meet or exceed these practices. Stream crossings will be limited. Increasing forest cover in riparian areas and upland forests adjacent to riparian areas and wetlands will moderate stream temperatures and mitigate flooding impacts.
Measure(s) to avoid, reduce, mitigate, or compensate negative impacts	N/A
Monitoring Plan	See D. MONITORING PLAN.

Impact	Soil quality – Protection from erosion and degradation (SDG Goal 15, Life on Land)

Risk Category	Positive – Soils will be protected from erosion and degradation by application of the best management practices referenced above. Harvests will be appropriately timed to minimize unnecessary disturbance to soils.
Measure(s) to avoid, reduce, mitigate, or compensate negative impacts	N/A
Monitoring Plan	See D. MONITORING PLAN.

5. For community-based projects, an assessment of the project's community risks and impacts
Not applicable.

F2. STAKEHOLDER COMMENTS

Not applicable.

G.

OWNERSHIP AND TITLE

G1. PROOF OF TITLE

Emissions reductions or enhanced removals created by the project are owned directly by the Project Proponents, Loon Echo and Mahoosuc Land Trusts, who hold full legal title in fee or in some cases through timber rights and thus have long term control of the land. The relevant deeds are provided separately for verification (Appendix A. Ownership Documentation).

G2. CHAIN OF CUSTODY

Not applicable.

G3. PRIOR APPLICATION

The project has not previously applied or been registered under any GHG emissions trading system or program.

H.

PROJECT TIMELINE

H1. START DATE

The project "Finite Carbon – Loon Echo & Mahoosuc Land Trusts IFM" has a project start date of October 8th, 2021, the date on which a Carbon Development Services Agreement between the Project Proponent and a purchaser of the ERTs was fully executed. This start date is appropriate and consistent with the ACR Standard v.7.0.

H2. PROJECT TIMELINE

Below is a schedule of the project activities in chronological order for important aspects of the project.

PROJECT ACTIVITY	DATE	SOURCE/NOTES
Project start date and start of crediting period	October 8, 2021	The date on which a Carbon Development Services Agreement between the Project Proponent and a purchaser of the ERTs was fully executed.
Forest carbon inventory	November 2021	
Validation and registration of the project	Anticipated 2022	
Frequency of monitoring, reporting and verification		Every 5 years or less, or at request for ERT issuance
End date of first crediting period	October 7, 2041	20 years
End date of project term	October 7, 2061	40 years