**Tennessee Nature Conservancy/UT AgResearch Working Woodlands Project**

**December 2021**

**The Nature Conservancy**

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# A. PROJECT OVERVIEW

## A1. PROJECT TITLE

Tennessee Nature Conservancy/UT AgResearch Working Woodlands Project

## A2. PROJECT TYPE AND PURPOSE/OBJECTIVE

Project type: Improved Forest Management

Purpose/objective: To improve carbon storage in standing biomass through improved forest management.

## A3. PROOF OF PROJECT ELIGIBILITY

Relevant eligibility requirements and demonstration that they are met by the project are elaborated below.

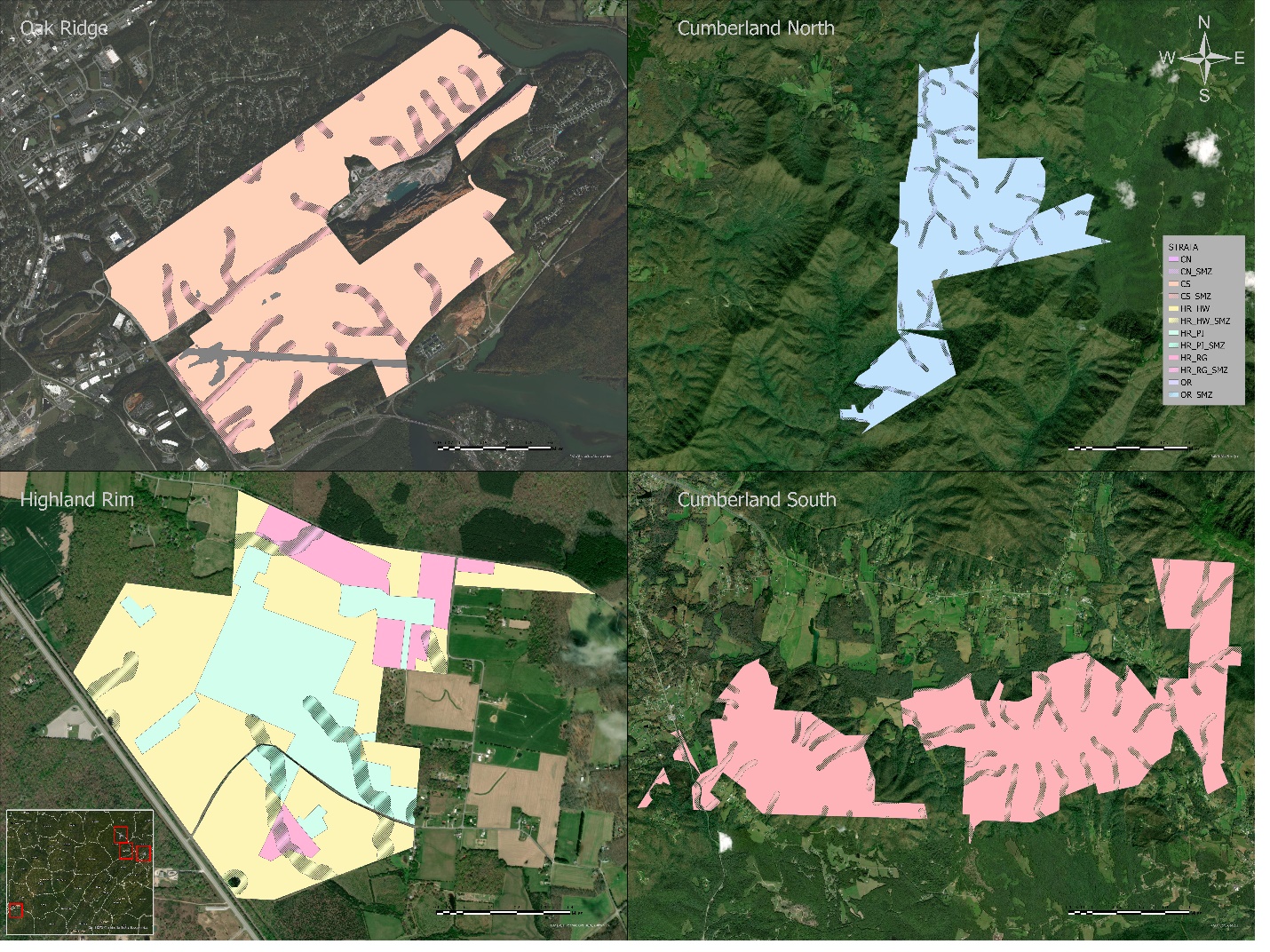
| **ACR Eligibility Requirement** | **Demonstration of compliance** |
| --- | --- |
| Start date | The project is being validated within three years of the November 26 2019 project start date. The methodology specifies that “The Start Date is when the Project Proponent began to apply the land management regime to increase carbon stocks and/or reduce emissions.”, which is marked by the date that the University of Tennessee (UT) signed an agreement with The Nature Conservancy (TNC) to develop a climate mitigation project. |
| Minimum project term | The project employs the ACR Standard v6.0 with requisite 40-year minimum project term (=commitment to project continuance, monitoring and verification). The minimum project term begins on the project start date of November 26 2019. |
| Crediting period | The project employs the ACR Standard v6.0 with requisite 20-year initial crediting period for IFM projects. |
| Real | The project will seek issuance of ex post credits, and not issuance of ex ante credits. |
| Direct emissions/Offset title/Land title | GHG emission reductions generated by the project activity are generated from forest carbon sources and sinks over which UT has all management and ownership rights. UT holds title to the project area (see Section G) |
| Additional | Additionality is demonstrated using the ACR Standard Three-Prong Additionality Test, demonstrating that the project activity is regulatory surplus, exceeds common practice, and faces either financial, technological or institutional barriers to implementation. See Section C. |
| Permanent | Permanence is addressed by the project through ongoing assessment of risk using the ACR Risk Tool and contributions to the ACR buffer pool. |
| Net of leakage | Leakage is accounted for applying the methodology. See Section E3. |
| Independently validated and verified | The project will be submitted for independent validation and verification. |
| Community and environmental impacts | Net positive community and environmental impacts are demonstrated. See Section F. |
| Forest definition | All areas qualify as “forestland” per the methodology ([Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal U.S. Forestlands](http://americancarbonregistry.org/carbon-accounting/ifm-methodology-for-non-federal-us-forestlands/Columbia%20Carbon%20ACR%20IFM%20Methodology_Semptember%202011.pdf) v1.3) definition of >10% stocking, or roughly around >8ft^2/acre basal area in trees >5” dbh. |
| Eligible landownership type | All landownership types, including private non-profits as in the case of this project, are eligible per the ACR Standard v6.0 |

As of the start date, there is currently no intent to seek registration of non-carbon environmental attributes from the project.

## 

## A4. LOCATION AND PHYSICAL CONDITIONS

The project property is located in the state of Tennessee, in Anderson, Franklin, Morgan and Scott Counties. A shapefile of the project area is archived in the project database (“UTK\_Strata\_\*.shp ”), and illustrated in Figure A. Central point Latitude, longitude: 35.994112, -84.216838.



**Figure A. University of Tennessee Improved Forest Management Project area.**

Physical conditions of the project area prior to project initiation are summarized below, and further detailed in the forest management plan “UTIA\_FMP\_Sections\_1\_9\_TC\*”

The project area is located within the greater Appalachian Highlands Region. Much of the soils on the project area are typical of those found on ridges and plateaus and in valleys. Parent materials include sandstone over residuum weathered from shale and siltstone and residuum weathered from limestone.

Forests in the project area had historically been subject to timber harvest, including high grading in some places. Additionally, past home sites and forest stands resulting from cleared agricultural fields are present on the project area.

The forests are typical of the region with respect to both their species composition and structure. Forest stands are generally mid- to late successional and species composition trending more toward shade tolerant species, such as maple (*Acer* spp.). There are relatively few early successional habitat types found on the project area. Natural regeneration of hardwoods has been the primary method of regeneration after timber harvests and natural disturbances.

## A5. BRIEF SUMMARY OF PROJECT

On November 26 2019, UT and TNC signed an agreement to develop forested properties owned and managed by UT University of Tennessee (UT) Forest Resources AgResearch and Education Center (FRREC)as a climate mitigation project, to be registered under the American Carbon Registry (ACR).

The UT Forest Resources AgResearch and Education Center is comprised of approximately 11,425 non-contiguous acres of real property spanning the four counties of Anderson, Franklin, Morgan, and Scott in central and eastern Tennessee. 11,364 acres of the Property are currently forested, with remaining non-forested lands being utilized primarily for UT FRREC facility footprint areas, equipment storage, and other directed agricultural research. The Property is divided into four separate forest units: the Highland Rim Forest, consisting of 861 forested acres; the Oak Ridge Forest, consisting of 2,145 forested acres; Cumberland Forest South, consisting of 3,994 forested acres; and Cumberland Forest North, consisting of 4,363 forested acres. Cumberland Forest North and Cumberland Forest South are sometimes collectively referred to herein simply as the Cumberland Forest.

## A6. PROJECT ACTION AND TECHNOLOGIES

The project activity is improved forest management, with UT’s improved forest management practices representing an improvement in carbon storage over higher return, more aggressive management regimes. The University of Tennessee Improved Forest Management Project will provide critical finance for the oversight and management of the properties.

The start date of this project is the date on which UT and TNC entered into an agreement to develop the forested properties owned and managed by UT as a climate mitigation project.

With the new 40 year partnership UT and TNC entered into, management activities on the property are now guided by a forest management plan completed and certified under the Forest Stewardship Council (FSC) as a part of TNC’s ongoing Working Woodlands Program1 on October 19, 2020 (see “UTIA\_FMP\_\*.pdf”);

New and clarified objectives and goals for the Property because of the partnership planning and project activity include:

1. Maintenance, restoration, and enhancement of the biological diversity, water quality, and ecological integrity of the UT Forest Resources AgResearch and Education Center through employment of long-term, sustainable forest management practices.
2. Meeting the requirements for FSC Certification and adhering to UT FRREC objectives pertaining to forest and land management.
3. Generation of revenues from sustainable production of forest products, including timber, recreation access, clean water, and carbon sequestration.
4. Sharing lessons learned and fostering future forest management innovation by establishing the Property as a working demonstration for ecologically-based land management, applied research, and educational outreach.
5. Establishment and fostering of positive, viable collaborations with other partners, researchers, and stakeholders to achieve individual and common objectives on a macro scale.
6. Contribution to local economies through creation and preservation of forest jobs, forest products, and compatible nature-based activities, including, but not limited to, outdoor recreation, as well as supporting local economic diversification through revenues generated therefrom.

Technologies to be applied in the project comprise silvicultural practices including predominately even-aged management (clearcuts and shelterwood harvests), but also some uneven-aged management (group selections). Levels of harvest and timber production in the project scenario, described in more detail in Section E6, will be substantially reduced from the baseline scenario, resulting in avoided emissions and steady recuperation and accrual of forest carbon stocks.

## A7. *EX ANTE* OFFSET PROJECTION

Estimates of GHG emission reductions and removal enhancements (before buffer contribution) for the first 20-year crediting period are provided in Table A1 below (derived in Section E).

**Table A1. Estimates of annual emission reductions and cumulative emission reductions (before buffer contribution)** **for the first crediting period. Throughout the GHG Plan, the convention is employed that project year refers to the interval from November 26 of the previous year to November 25 of the corresponding year.**

|  |  |  |
| --- | --- | --- |
| **Project Year** | **Annual net GHG emission reductions (t CO2)** | **Cumulative emission reductions earned (t CO2)** |
| 2020 | 89,192 | 89,192 |
| 2021 | 69,955 | 159,147 |
| 2022 | 73,588 | 232,735 |
| 2023 | 75,897 | 308,632 |
| 2024 | 84,882 | 393,514 |
| 2025 | 25,668 | 419,182 |
| 2026 | 79,128 | 498,310 |
| 2027 | 80,421 | 578,731 |
| 2028 | 82,046 | 660,777 |
| 2029 | 92,094 | 752,871 |
| 2030 | 13,292 | 766,163 |
| 2031 | 22,885 | 789,048 |
| 2032 | 22,885 | 811,933 |
| 2033 | 22,885 | 834,818 |
| 2034 | 31,597 | 866,415 |
| 2035 | - | 866,415 |
| 2036 | - | 866,415 |
| 2037 | 6,345 | 872,760 |
| 2038 | 22,406 | 895,166 |
| 2039 | 22,406 | 917,572 |
| First Crediting Period Total | 917,572 | 917,572 |

## A8. PARTIES

*List full contact information, roles, and responsibilities for project proponent, other project participants, relevant regulator(s) and/or administrators of any GHG Program(s) in which the project is already enrolled, and the entities holding offset and land title (if applicable).*

*Project Proponent and landowner, responsible for land management, contact information:*

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*Offset project consultant or project developer contact information:*

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# B. METHODOLOGY

## B1. APPROVED METHODOLOGY

[Improved Forest Management Methodology for Quantifying GHG Removals and Emission Reductions through Increased Forest Carbon Sequestration on Non-Federal U.S. Forestlands](http://americancarbonregistry.org/carbon-accounting/ifm-methodology-for-non-federal-us-forestlands/Columbia%20Carbon%20ACR%20IFM%20Methodology_Semptember%202011.pdf) version 1.3 (April 2018).

(hereafter referred to as the “methodology”)

## B2. METHODOLOGY JUSTIFICATION

The chosen methodology is appropriate for improved forest management on private lands in the U.S. Relevant applicability conditions and demonstration that they are met by the project are elaborated below.

| **Methodology applicability conditions, referencing modifications currently in process, and likely to be accepted by ACR.** | **Demonstration of compliance** |
| --- | --- |
| Applicable only on non‐federally owned forestland within the United States | The project area is state-owned and located in the United States |
| The methodology applies to lands that can be legally harvested by entities owning or controlling timber rights on forestland | UT owns and controls timber rights to the property. |
| Private or non-governmental organization ownerships subject to timber harvesting in the with-project scenario must be certified by FSC, SFI, or ATFS or become certified within one year of the project Start Date | Not applicable |
| All Tribal lands in the United States, except those lands that are managed or administered by the Bureau of Indian Affairs, are eligible under this methodology | Not applicable |
| If harvesting occurs in the with-project scenario on public non-federal ownerships, the property must:   * be certified by FSC, SFI, or ATFS or become certified within one year of the project Start Date; or * have its forest management plan sanctioned by a unit of elected government officials within a state, or a state agency, or a federal agency; * and have its forest management plan updated at minimum every 10 years. | The project area has FSC Certification as of October 19, 2020 <https://info.fsc.org/details.php?id=a0240000005sSaVAAU&type=certificate> |
| Use of non‐native species is prohibited where adequately stocked native stands were converted for forestry or other land uses after 1997 | The project area is composed entirely of native forest types and no non-native species will be planted. |
| Draining or flooding of wetlands is prohibited | The project activity does not involve any hydrological manipulation of wetlands. |
| Project proponent must demonstrate its ownership or control of timber rights at the project start date | The project area has been under UT ownership as of the November 26 2019 start date and continues under UT ownership. |
| The project must demonstrate an increase in on‐site stocking levels above the baseline condition by the end of the Crediting Period | The project is expected to increase on‐site stocking levels above the baseline condition by the end of the Crediting Period (consistent with FVS-SN projections produced in this report) |

## B3. PROJECT BOUNDARIES

The project area boundary is delineated in a shape file archived in the project database and illustrated above in Figure A1. All areas qualify as “forestland” per the methodology definition of >10% stocking (i.e. roughly around >8ft^2/acre basal area in trees >5” dbh), and not currently developed for non-forest uses. Non-forest land cover/use classes on the property were excluded.

The project area (file “UTK\_Strata\*.shp ”) was delineated as follows:

*Property boundary and Stratification Process*

The UT property boundary shapefile was originally created by UT. The shapefile was reviewed against official plat maps of the UT property to ensure that the shapefile boundary lines matched up with the official deeds. Some minor adjustments were made to the UT boundary lines based on the plat maps, and observations of boundary lines made in the field. The properties were stratified based first on contiguous area. Cumberland North, Cumberland South, and Oak Ridge were each designated as their own stratum. Highland Rim was subdivided based on management and forest type as assessed by aerial imagery and ground-truthing in the field. The recently harvested area of Highland Rim was designated as Highland Rim Regen (HR\_RG). The pine forest at Highland Rim was designated Highland Rim Pine (HR\_PI), and the Highland Rim mixed hardwood forest was designated Highland Rim Hardwood (HR\_HW).

*SMZ Delineation Process*

The State of Tennessee Best Management Practices[[1]](#footnote-1) recommend that Streamside Management Zones (SMZ) are delineated around all perennial and intermittent bodies of water. Using the National Hydrography Dataset (NHD) provided by the USGS, we mapped perennial and intermittent streams and rivers using the ‘Flowline’ from the NHD geodatabase for the State of Tennessee[[2]](#footnote-2). We selected attributes that designate each flowline section as FCODE ‘perennial’ and ‘intermittent’. We also included all water bodies in the ‘NHD Area’ layer. We conservatively delineated the maximum buffer distance of 145’ on either side of the center line for all water features included using aforementioned criteria. This buffer area was then designated as an SMZ for all strata.

The first project crediting period is from November 26 2019 to November 25 2039. The project term extends through November 25 2059.

## B4. IDENTIFICATION OF GHG SOURCES AND SINKS

The project includes the carbon pools and GHG sources detailed in Table B1.

**Table B1. Carbon Pools and GHG Emissions Sources Included in the Project Boundary.**

|  |  |  |
| --- | --- | --- |
| **Carbon pools** | **Included / Excluded** | **Justification / Explanation of Choice** |
| Above‐ground biomass  carbon | Included | Major carbon pool subjected to the project activity. The project employs a minimum dbh of 1”. |
| Below‐ground biomass  carbon | Included | Major carbon pool subjected to the project activity. The project employs a minimum dbh of 1”. |
| Standing Dead Wood | Included | Major carbon pool subjected to the project activity. The project employs a minimum dbh of 5”. |
| Lying Dead Wood | Excluded | This pool is conservatively excluded. Lying dead wood is optional to include. |
| 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* as a result of project implementation |
| Soil Organic Carbon | Excluded | Changes in the soil organic carbon pool are considered *de*  *minimis* as a result of project implementation |
| Emissions from Biomass Burning | Included | This pool is included. It is conservatively assumed to be zero in the baseline. No logging slash is burnt in either the baseline or with-project cases as part of management practices. |
| Market Leakage | Included | As more wood is harvested in the baseline than in the project scenario, market leakage is accounted for to reflect that wood supply elsewhere increases in response to project activity-attributable reductions, assuming demand is constant. |

## B5. BASELINE

The baseline determination was conducted as required, which is to maximize the NPV of wood products over a 100-year modeling period using the prescribed discount rate, in this case 4% for non-federal public lands.  Constraints were introduced into the NPV model that reflect operational realities of the ownership and a reasonable prediction of what harvesting would likely occur in the absence of the carbon project.   The introduced constraints (see E. Quantification *NPV analysis*) resulted in a significantly more conservative baseline than required by the methodology.  Derivation and justification for the baseline is detailed in Section E.

## B6. PROJECT SCENARIO

The project activity is improved forest management, via implementation of UT’s improved forestry practices summarized in Section A6.

## B7. REDUCTIONS AND ENHANCED REMOVALS

The project activity produces net emission reductions by increasing stocking relative to the baseline, via improved forest management practices previously described in Section A6.

## B8. PERMANENCE

Risks that may substantially affect the project’s GHG emission reductions or removal enhancements include fire, forest pests, climate change, and failure of project activity to avoid unsustainable forest resource extraction and land use change.

The project addresses permanence by application of the ACR Tool for Risk Analysis and Buffer Determination v1.0, to assess risk of reversal and withhold from issuance a commensurate percentage of ERTs, to be held in reserve in the ACR buffer pool. The initial risk analysis is detailed below, and will be updated at each verification.

The project has an initial risk rating of 16% based on application of the ACR Tool for Risk Analysis and Buffer Determination, detailed in the table below.

|  |  |
| --- | --- |
| **Applicable risk category** | **Risk value** |
| 1. Financial | 3% (US Public and Tribal Lands) |
| 1. Project Management | 3% (US Public and Tribal Lands) |
| 1. Social/Policy | 2% (Default Value) |
| 1. Conservation Easement Deduction | 0% (No easement) |
| 1. Fire | 2% (project is located in low fire risk region[[3]](#footnote-3)) |
| 1. Diseases and Pests | 4% Default Value[[4]](#footnote-4) |
| 1. Levee Failure and Water Table Changes | 0% (<60% of the project area is a forested wetland; see below) |
| 1. Other Natural Disaster Events | 2% Default Value |
| **TOTAL** | 16% |

To assess areal proportion of forested wetland, we clipped the 2011 Southeast GAP raster dataset and the 2016 NLCD dataset to the approximate project area. The relevant forested wetland land use classifications include “Central Hardwoods Floodplain Forest” from SE-GAP and “Woody Wetland” from NLCD. As detailed in the table below, the project area contains <2% forested wetland, well below the 60% wetland threshold specified in the ACR Risk Tool.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data** | **Land Type** | **Approximate wetland acres** | **Approx. total acres** | **% Area** |
| GAP 2011 | Central Hardwoods Floodplain Forest | 171 | 11,366 | 1.5% |
| NLCD 2016 | Woody Wetland | 15 | 11,366 | 0.1% |

The Minimum Buffer Percentage for the project is 16%, and the projected Buffer Contribution amount for the initial 20-year baseline period is 213,339 t CO2e (see “ACR\_Calcs UTK\*.xls”).

# C. ADDITIONALITY

## C1. REGULATORY SURPLUS TEST

The project activity is not required by law. There are no state or federal regulatory restrictions on forest management that apply to the project area. Nevertheless, voluntary Tennessee Best Management Practices (BMPs[[5]](#footnote-5)) restrictions around Streamside Management Zones (SMZs) are conservatively incorporated in both the baseline and with-project scenarios (see Section E), and thus compliance with BMPs is not included in accounting of ERTs.

## C2. COMMON PRACTICE TEST

At the time of the project start date, ca. 2019, most forest managers in the project region were motivated to harvest as much timber as possible with little investment and eventually to sell the land, and few were committed to long-term forest management or conservation. In particular, UT’s focus through participation in this carbon project on improved forest management and research forestry contrasts starkly with the more aggressive, predominately even-aged management regimes practiced by other forest ownerships in the region.

UT is a unique landowner in the region, and so identification of similar landowners to establish common practice is problematic. Other state of TN agencies own and manage land (e.g. TN Division of Forestry, TN Wildlife Resources Agency), but operate with different objectives.

We identified public university forests in the southeastern and south central United States, representing similar landowners, and evaluated the extent of adoption of forest certification. Forest certification under FSC is a central component to the UT project activity.

As of 2021, among 18 public university forests identified, only 6 (33%) were certified under either FSC, SFI or ATFS, and only 3 (17%) were certified under FSC, arguably the most restrictive certification scheme. Certification cannot be considered common practice among this class of landowners, and thus the UT project activity goes beyond common practice.

Although harder to evaluate, other elements of the UT project activity, including implementation of specific climate smart forestry practices, including shortleaf pine and oak restoration, and management of intact corridors, are unlikely to represent common practice among public university forests in the region.

Common practice is also reflected in average stocks in the project region, which have been assessed by the California Air Resources Board (ARB) from US Forest Service Forest Inventory and Analysis (FIA) data[[6]](#footnote-6). These values of average live carbon stocking, at the regional level and by forest type, reflect the outcomes of management regimes in practice across the landscape.

Weighted average common practice stocking per ARB of 137 t CO2/acre in live above and belowground biomass equivalent, conservatively referencing high site class values (Table C1, calculations in “UTCommonPracticeCalcs\*.xls”), is well below the projected stocking outcome in the with-project scenario, expected to average ~190 t CO2/acre over the first 20-years of the project term under a sustained yield management regime (Section E6). Thus, management in the with-project case can be characterized as producing outcomes not achieved by typical common practice.

**Table C1. Comparison with (area-weighted average) 2015 ARB common practice values for the Allegheny & North Cumberland Mountains and Eastern Broadleaf Forest Cumberland Plateau supersections.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **stratum** | **acres** | **Species in order of relative basal area** | **ARB supersection** | **ARB assessment area** | **Equivalent\* ARB common practice avg ABGB t CO2/ac**  **(high site class)** | |
| CN | 4,363.0 | Chestnut oak, tulip poplar, red maple | Allegheny & North Cumberland Mountains | oak-hickory | 143.16 | |
| CS | 3,994.3 | Chestnut oak, red maple, tulip poplar | Allegheny & North Cumberland Mountains | oak-hickory | 143.16 | |
| OR | 2,145.5 | Chestnut oak, tulip poplar, white oak | Eastern Broadleaf Forest Cumberland Plateau | oak-hickory | 130.08 | |
| HR\_HW | 505.5 | Southern red oak, scarlet oak | Eastern Broadleaf Forest Cumberland Plateau | oak-hickory | 130.08 | |
| HR\_PI | 254.3 | Loblolly pine | Eastern Broadleaf Forest Cumberland Plateau | pine | 56.4 | |
| HR\_RG | 101.3 | Shortleaf pine | Eastern Broadleaf Forest Cumberland Plateau | pine | 56.4 | |
| *Weighted average* | | | | | | 137.4 |

\*converted from aboveground to above and belowground assuming 20% root:shoot ratio

## C3. IMPLEMENTATION BARRIERS TEST

The project activity faces a financial barrier. Net present values were calculated referencing the baseline and project scenarios outlined in Sections E1 and E6 below, at a 4% discount rate over the 20-year crediting period from 2019 to 2038.

The project activity, without carbon revenue, is expected to generate $3,110,822.

NPV (in 2019 $$) in timber revenue, unambiguously lower than the return in the baseline NPV maximization scenario expected to yield NPV (in 2019 $$) of $18,733,560, (documented in “NPV additionality UTK\*.xlsx”). Thus, the project activity is clearly not the most profitable forest management use.

## C4. PERFORMANCE STANDARD TEST

Not applicable.

# D. MONITORING PLAN

## D1. MONITORED DATA AND PARAMETERS

Live and dead tree stocks will be monitored via forest inventory conducted every 5 years or less, with field measurement and estimation procedures consistent with those outlined in Section E1 below.

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](http://americancarbonregistry.org/carbon-accounting/ifm-methodology-for-non-federal-us-forestlands/Columbia%20Carbon%20ACR%20IFM%20Methodology_Semptember%202011.pdf) v1.3, will be monitored.

Note that QA/QC procedures for data and parameters related to baseline uncertainty (not monitored) are provided in “FINAL UTIA forest C inventory SOPs \*”, to ensure accurate and precise measurement data was collected in the inventory used to derive the project baseline. Subsequent growth and yield modeling using FVS-SN applied best practices, calibrating the model with location and site class data.

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | *CP,TREE,t* |
| *Unit of Measurement* | metric tons CO2 |
| *Description* | Carbon stored in above and below ground live trees at the beginning of the year *t* |
| *Data Source* | Forest inventory. |
| *Measurement Methodology* | To be consistent with field measurement protocols specified in “FINAL UTIA forest C inventory SOPs \*”. |
| *Data Uncertainty* | To be calculated as the mean +/- 90% confidence interval |
| *Monitoring Frequency* | Every 5 years or less, or at request for ERT issuance |
| *Reporting Procedure* |  |
| *QA/QC Procedure* | To be consistent with field measurement protocols specified in “FINAL UTIA forest C inventory SOPs \*”. The inventory will use a stratified systematic sample design and re-measure the same permanent plots established in 2020, which targeted a precision level of +/- 7% of the mean live tree biomass with 90% confidence. |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | *CP,DEAD,t* |
| *Unit of Measurement* | metric tons CO2 |
| *Description* | Carbon stock stored in dead wood at the beginning of the year *t*  Standing dead wood only (lying dead wood excluded from project accounting boundary). |
| *Data Source* | Forest inventory. |
| *Measurement Methodology* | To be consistent with field measurement protocols specified in “FINAL UTIA forest C inventory SOPs \*”. |
| *Data Uncertainty* | To be calculated as the mean +/- 90% confidence interval |
| *Monitoring Frequency* | Every 5 years or less, or at request for ERT issuance |
| *Reporting Procedure* |  |
| *QA/QC Procedure* | To be consistent with field measurement protocols specified in “FINAL UTIA forest C inventory SOPs \*”. The inventory will use a stratified systematic sample design and re-measure the same permanent plots established in 2020, which targeted a precision level of +/- 7% of the mean live tree biomass with 90% confidence. |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | Project area |
| *Unit of Measurement* | Acres |
| *Description* | Area of IFM project |
| *Data Source* | Validated project GHG Plan |
| *Measurement Methodology* | Not re-measured – area remains fixed through crediting period.  Determination of project area documented in Section B3 of the project GHG Plan. |
| *Data Uncertainty* | None |
| *Monitoring Frequency* | Not monitored. |
| *Reporting Procedure* | Reported in GHG Plan and all monitoring reports. |
| *QA/QC Procedure* | Project area boundary truthed with aerial imagery and on-site inspections with a GPS.  Plat map and GIS datasets used were geo-registered referencing corner points, clear landmarks or other intersection points. |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | Sample plot area |
| *Unit of Measurement* | Acres (variable, nested) |
| *Description* | Area (variable, nested) of forest inventory sample unit |
| *Data Source* | Standard Operating Procedures document “FINAL UTIA forest C inventory SOPs \*”. |
| *Measurement Methodology* | As per standard operating procedures detailed in “FINAL UTIA forest C inventory SOPs \*”, employing nested fixed-radius plots. Plot centers are permanently marked in the field. |
| *Data Uncertainty* | None |
| *Monitoring Frequency* | Sample plot area is not monitored. Sample plots are to be re-measured every 5 years or less. |
| *Reporting Procedure* | Reported in project monitoring reports. |
| *QA/QC Procedure* | As per detailed quality control procedures outlined in “FINAL UTIA forest C inventory SOPs \*”. |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | Tree species |
| *Unit of Measurement* | Taxon (to species level) |
| *Description* | Species of tree measured in forest inventory sample unit |
| *Data Source* | Forest inventory |
| *Measurement Methodology* | As per standard operating procedures detailed in “FINAL UTIA forest C inventory SOPs \*”. |
| *Data Uncertainty* | None |
| *Monitoring Frequency* | Sample plots are to be re-measured every 5 years or less. |
| *Reporting Procedure* | Reported in project monitoring reports. |
| *QA/QC Procedure* | As per detailed quality control procedures outlined in “FINAL UTIA forest C inventory SOPs \*”. Inventory field crew members will be trained in or have familiarity with regional dendrology. |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | CP,HWP,t |
| *Unit of Measurement* | metric tons CO2 |
| *Description* | Carbon remaining stored in wood products 100 years after harvest for the project in year t. |
| *Data Source* | Monitored from harvest volumes estimated from pre-sale cruises, in the case of stumpage sales, or from scaled mill receipts in the case of producer sales (where UT cuts and hauls timber to a receiving mill). |
| *Measurement Methodology* |  |
| *Data Uncertainty* |  |
| *Monitoring Frequency* | Annual data summed for the monitoring period, applied as average annual for the monitoring period |
| *Reporting Procedure* |  |
| *QA/QC Procedure* | Timber grading applies US Forest Service procedures, documented in “US Forest Service Log Grade Field Card.doc”, and volumes calculated from cruise data using “TPlot for Foresters 16 tabs June 2020.xlsx” |
| *Notes* |  |

|  |  |
| --- | --- |
| *Data or Parameter Monitored* | *BSP,t* |
| *Unit of Measurement* | in metric tons CO2 |
| *Description* | Carbon stock in logging slash burned in the project in year *t* |
| *Data Source* |  |
| *Measurement Methodology* | Burning is not a routine part of management practices. Where burning is implemented (e.g. prescribed burning for site prep), the area will be delineated and any mortality assessed via field measurements.  Surveillance of slash management on harvests is performed on FSC audits via visual census. |
| *Data Uncertainty* |  |
| *Monitoring Frequency* | Annual |
| *Reporting Procedure* |  |
| *QA/QC Procedure* | Monitoring and measurement of logging slash will be conducted by a professional forester. |
| *Notes* |  |

# E. QUANTIFICATION

## E1. BASELINE

Baseline analysis began with a forest carbon inventory of the project area, conducted from March to April 2020. The inventory employed a systematic, stratified sample design with nested fixed-radius plots; field measurement protocols are documented in “FINAL UTIA forest C inventory SOPs \*”. Minimum diameter at breast height (dbh) for live trees was set at 1” and for standing dead wood was set at 5”. Panther Creek Forestry, LLC carried out the field work.

Strata were delineated to conform with parcel boundaries (management units), and to further delineate mature hardwoods and young (approximately 10-20 years old) pines on the Highland Rim property. The Nature Conservancy produced the initial stratification using base GIS layers provided by UT, developed from stand typing determined by a combination of aerial imagery evaluation and field-truthing. Boundaries were subsequently refined referencing Google Earth imagery and in further consultation with UT (regarding stand histories and timber sales). Property boundaries were confirmed against county property parcel maps. Non-forest areas were delineated and excluded from the inventory (project) area referencing Google Earth imagery and input from UT staff (see also above Section B3).

The final stratification is illustrated in Figure A1 and detailed in Table E1. Details on the sample design and data analysis are documented in “UT inventory results 2020\*.doc” and “UTK inventory calcs and stats\*.xlsx”. The Highland Rim – regen (HR\_RG) stratum was regenerated in 2014, and was not inventoried (i.e. conservatively assumed to be equal to zero measurable biomass as of the November 2019 start date).

**Table E1. UT IFM project inventory design.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Strata** | **Cumberland Forest – North**  **CN** | **Cumberland Forest – South**  **CS** | **Oak Ridge**  **OR** | **Highland Rim – hardwood**  **HR\_HW** | **Highland Rim – pine**  **HR\_PI** | **Highland Rim – regen**  **HR\_RG** | **Total** |
| Area (ac) | 4,363.0 | 3,994.3 | 2,145.5 | 505.5 | 254.3 | 101.3 | 11,363.8 |
| **SAMPLE SIZE** | **56** | **41** | **29** | **8** | **9** | **Not sampled** | **143** |

*Inventory analysis and results*

Total aboveground biomass carbon was estimated from inventory data applying species group-specific allometric equations sourced from Jenkins et al 2003[[7]](#footnote-7).

For all trees, total aboveground biomass was adjusted to deduct any portion observed missing (referencing defect assessments for the top, middle and bottom thirds of the total aboveground biomass of inventory trees). Deductions for defect were incorporated by multiplying total aboveground biomass by weighted average overall percent sound (1 – recorded percent defect) referencing the proportions of aboveground tree biomass represented in each of three assessed thirds (table below referenced from Climate Action Reserve 2012).

Allocations of total aboveground biomass in top, bottom and middle thirds:

|  |  |
| --- | --- |
| **Tree Portion** | **Percent of Tree Biomass** |
| Top 1/3 | 10% |
| Middle 1/3 | 25% |
| Bottom 1/3 | 65% |

For standing dead trees of decay class 4 (bole only), middle and bottom third defects were applied to the entirety of the bole biomass (assuming the top third represents missing tops and branches), and percents of bole biomass calculated as 27.8% and 72.2%, respectively.

Root biomass was estimated from total aboveground biomass using component ratios from Jenkins et al 2003, to produce total live tree biomass. Total live tree biomass was multiplied by 0.5 to estimate carbon fraction, then multiplied by 3.664 to calculate CO2 equivalent.

Carbon in standing dead wood was estimated in the same way as for live trees, with deductions for decay class recorded in the field (Table E4). For all standing dead wood, only aboveground biomass was included in carbon calculations.

**Table E4. Decay class descriptions and deductions for standing dead wood.**

|  |  |  |
| --- | --- | --- |
| ACR decay class | Description standing dead | Deduction |
| 1 | Tree with branches and twigs that resembles a live tree (except for leaves). | 0.97 |
| 2 | Tree with no twigs but with persistent small and large branches. | 0.95 |
| 3 | Tree with large branches only. | 0.9 |
| 4 | Bole only, no branches. | 0.8 |

Carbon stock estimates derived from the March/April 2020 inventory measurements were assumed to be the same as of the November 26 2019 project start date.

Results for above- and belowground (live and dead) tree biomass are documented in “UTK inventory calcs and stats \*.xls”. Estimated total stock in live and dead trees at the project start date of November 26 2019 is

|  |
| --- |
| 2,255,367.4 |

t CO2 (= 200.3 t CO2/ac \* 11,262.4 inventoried acres).

***NPV ANALYSIS***

*Discount rate assumption*

We analyzed the Net Present Value (NPV) of projected cash flows for each baseline stratum for each year over a 100-year period to determine the baseline management scenario. For purposes of our NPV analysis, we used a real discount rate of 4%, the rate for non-federal public lands stated in the methodology.

The project chose to calculate a baseline management scenario that reflects what the University would be more likely to implement to meet increased financial needs over much of the 20-year baseline period. The baseline scenario reflects that forest managers would implement even-aged management via clearcuts on all non-SMZ strata, except the HR\_RG stratum, totaling ~480 acres harvested every year for a 20-year period (~640 over a 15-year period), starting in year 1. We acknowledge that the harvest intensity would likely be irregular, however, we averaged the estimated acres to be harvested over 15 years, as a reasonable estimate of the overall harvesting intensity during that time period. The baseline harvest intensity equates to ~4% annually of the total forest over 20 years.

**High value timber stocking.** Approximately 90 percent (10,200 acres) of The University of Tennessee forested properties are comprised of even aged hardwood stands 70-90 years old. These hardwood forests have reached the age where they are financially mature and in economic terms ready to be harvested. The economic return of the forests will continue to decline as they age, increasing the likelihood that the forests would be harvested in the coming years. These economically mature forests, coupled with high value hardwood species such as oak and hickory, provide significant conservation value to the region as well as economic value to the University.

*Growth and yield modeling*

The FVS-SN model was calibrated to the project area entering the FVS location code 80216 (Stearns District, Daniel Boone NF) and site index, determined using the NRCS Web Soil Survey database. Ecoregion codes were set as follows:

North and South Cumberland – M221Cd (Southern Cumberland Mountains)

Oak Ridge – 221Ja (Rolling Limestone Hills)

Highland Rim (all strata) – 223Eb (Eastern Karst Plain)

We calculated the approximate area-weighted average site index within each stratum, as shown in Table E5, below and documented in “UTK\_site\_index.xlsx”. The site index was established based on a reference tree species for each stratum. Reference species were selected based on relative dominance (in terms of basal area) and extent of areal representation in the NRCS dataset. For the HR\_RG stratum, we selected shortleaf pine as the reference species because this is the anticipated dominant species in the stratum.

**Table E5. Summary of Site Index for each stratum in the UT IFM project area using the NRCS Web Soil Survey. The site index is the average height, in feet, that dominant and codominant trees of a given species attain at age 50. The site index applies to fully stocked, even-aged, unmanaged stands (NRCS).**

|  |  |  |
| --- | --- | --- |
| **Stratum** | **Site Index (Area-weighted average based on NRCS Soil Data Viewer)** | **Reference Tree Species** |
| CN | 90 | Yellow poplar |
| CS | 90 | Yellow poplar |
| HR\_HW | 75 | Southern red oak |
| HR\_PI | 73 | Loblolly pine |
| OR | 65 | White oak |
| HR\_RG | 70 | Shortleaf pine |

The FVS “NoTriple” command was entered to avoid excessive tree records and speed processing, and to track individual trees and permit cross-referencing to inventory dataset.

To compute the net present value for each stratum, we first modeled harvestable timber from sawlogs and from pulp from the 2020 inventory data for 100 years using FVS-SN, using the specifications applied above. The un-inventoried HR\_RG stratum, regenerated in 2014, was “planted” in FVS entering data on average height and trees per acre by species collected on 10 fixed area (1/100 ac) plots measured in the stratum during the 2020 inventory (Table E6).

**Table E6. Stem data from fixed area plots in HR\_RG stratum, used to populate FVS.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **Average Height (ft)** | **Average TPA** | **Age** |
| Shortleaf pine | 12 | 10 | 6 |
| Other hardwood | 11 | 130 | 6 |
| Red maple | 11\* | 10 | 6 |
| Southern red oak | 13 | 40 | 6 |

\*no data, assigned average height for 1” stem

Model projections were made for the following management scenarios, run for each stratum:

| **Scenario** | **Harvest/management scenario** | **To determine:** |
| --- | --- | --- |
| “grow” and “SMZ” (= FVS runs coded “r001”) | Allow existing stocks to grow 100 years | Year in which stratum would be first clearcut.  Year in which stratum would be first thinned to 50% residual “overstory canopy”, compliant with Tennessee BMPs (assuming thin throughout a diameter range with proportion of basal area cut set at 50%). |
| “rot” (= FVS runs coded “r002”) | Clearcut, regeneration via sprouting, grow 100 years | Optimal rotation age |

Volume yields were output for 100-year projections from FVS-SN, with annual yields interpolated between 5-year cycle outputs.

*Revenues*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We then projected the revenues from sawlogs and pulp using the average stumpage price for pine and hardwood (whichever represented the majority of projected harvested volumes for that stratum). Stumpage prices were sourced from TimberMart South Tennessee Stumpage Prices Quarterly report for Q4 2019 (see accompanying document “TENNESSEE 4Q2019”):   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Stratum** | **Species in order of relative basal area** | **Predominant timber** | **pulp $/ft^3** | **saw $/ft^3** | | CN | Chestnut oak, tulip poplar, red maple | hardwood | $ 0.25 | $ 0.84 | | CS | Chestnut oak, red maple, tulip poplar | hardwood | $ 0.25 | $ 0.84 | | HR\_HW | Southern red oak, scarlet oak, | hardwood | $ 0.25 | $ 0.84 | | HR\_PI | Loblolly pine | pine | $ 0.23 | $ 0.67 | | HR\_RG | Shortleaf pine | pine | $ 0.23 | $ 0.67 | | OR | Chestnut oak, tulip poplar, white oak | hardwood | $ 0.25 | $ 0.84 |   As a state institution, UT pays no property taxes for the project properties. We did not separately project costs related to cutting, hauling and delivery because they are implicitly accounted for in the stumpage prices. An extensive road network already exists in the project area (e.g. existing old strip mine roads on the Cumberland Forests), and no new road construction is necessary to facilitate harvests.  *NPV calculation and optimal harvest scheduling*  For each stratum and harvest scenario, we calculated the NPV of cash flows at each year during the 100-year period using the 4% real discount rate.  The results of our analysis are presented below (and in “NPV UTK\*.xls”) and support the basis for the management scenarios incorporated in the project baseline.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Stratum** | **harvest** | **abbreviation** | **FVS-SN projection source** | **max NPV revenues ($/acre)** | **Model year** | | CN | First clearcut | CN grow | “NPV”, stand “CN”, MgmtID “A001” | $2,593 | 0 | | CS | First clearcut | CS grow | “NPV”, stand “CS”, MgmtID “A001” | $2,215 | 0 | | OR | First clearcut | OR grow | “NPV”, stand “OR”, MgmtID “A001” | $1,628 | 0 | | HR\_HW | First clearcut | HR\_HW grow | “NPV”, stand “HR\_HW”, MgmtID “A001” | $1,552 | 1 | | HR\_PI | First clearcut | HR\_PI grow | “NPV”, stand “HR\_PI”, MgmtID “A001” | $1,809 | 0 | | HR\_RG | First clearcut | HR\_RG grow | “NPV”, stand “HR\_RG”, MgmtID “A001” | $86 | 65 | | CN | First thinning | CN SMZ | “NPV”, stand “CN”, MgmtID “A001” | $1,296 | 0 | | CS | First thinning | CS SMZ | “NPV”, stand “CS”, MgmtID “A001” | $1,107 | 0 | | OR | First thinning | OR SMZ | “NPV”, stand “OR”, MgmtID “A001” | $814 | 0 | | HR\_HW | First thinning | HR\_HW SMZ | “NPV”, stand “HR\_HW”, MgmtID “A001” | $776 | 1 | | HR\_PI | First thinning | HR\_PI SMZ | “NPV”, stand “HR\_PI”, MgmtID “A001” | $904 | 0 | | HR\_RG | First thinning | HR\_RG SMZ | “NPV”, stand “HR\_RG”, MgmtID “A001” | $43 | 65 | | CN | Optimal rotation | CN rot | “NPV”, stand “CN”, MgmtID “A002” | $152 | 70 | | CS | Optimal rotation | CS rot | “NPV”, stand “CS”, MgmtID “A002” | $215 | 60 | | OR | Optimal rotation | OR rot | “NPV”, stand “OR”, MgmtID “A002” | $209 | 53 | | HR\_HW | Optimal rotation | HR\_HW rot | “NPV”, stand “HR\_HW”, MgmtID “A002” | $230 | 50 | | HR\_PI | Optimal rotation | HR\_PI rot | “NPV”, stand “HR\_PI”, MgmtID “A002” | $224 | 43 |   Note that none of the post-clearcut scenarios justifies a repeat cut within the first 20-year crediting period. The management regimes derived from the above analysis and applied in the 20-year baseline scenario include initial clearcuts. SMZs are left untouched. No cuts are justified in the 20-year baseline scenario in the HR\_RG stratum.  Clearcuts are a recommended even-aged management practice per University of Tennessee Agricultural Extension Service “Forest Practice Guidelines for Tennessee” (UT Agricultural Extension publication PB1523).  The timetable of harvests was staggered over 15 years.  *Legal constraints*  There are no state or federal regulatory restrictions on forest management that apply to the project area. The baseline goes over and above voluntary Tennessee BMP restrictions around Streamside Management Zones, assuming no harvest in these areas.  ***Baseline management scenarios*** *(StandID corresponds to models runs in “UTK FVS BSL REV Stand C\*.xls” and “UTK FVS BSL REV Cutlist \*.xls”. Unharvested strata are modeled from projections in “wp live tree proj UT\_revDec2020”*)   |  |  | | --- | --- | | **Stratum (sub-stratum)** | **Management regime** | | CN (non SMZ)  3,750 acres | 15 equally-sized cohorts clearcut to minimum 5” dbh in consecutive years from 2020 to 2034, regeneration via sprouting. | | CS (non SMZ)  3,376 acres | 15 equally-sized cohorts clearcut to minimum 5” dbh in consecutive years from 2020 to 2034, regeneration via sprouting. | | OR (non SMZ)  1,833 acres | 15 equally-sized cohorts clearcut to minimum 5” dbh in consecutive years from 2020 to 2034, regeneration via sprouting. | | HR\_RG (non SMZ)  88 acres | StandID HR\_RG: No harvest. | | HR\_HW (non SMZ)  461 acres | 15 equally-sized cohorts clearcut to minimum 5” dbh in consecutive years from 2020 to 2034, regeneration via sprouting. | | HR\_PI (non SMZ)  226 acres | 15 equally-sized cohorts clearcut to minimum 5” dbh in consecutive years from 2020 to 2034, regeneration via sprouting. | | CN (SMZ)  612 acres | No harvest. | | CS (SMZ)  618 acres | No harvest. | | OR (SMZ)  313 acres | No harvest. | | HR\_RG (SMZ)  13 acres | StandID HR\_RG: No harvest. | | HR\_PI (SMZ)  28 acres | No harvest. | | HR\_HW (SMZ)  44 acres | No harvest. | |

*Baseline projections*

The scenarios above were projected in FVS-SN for the period 2020 to 2039. Projections were annualized using linear interpolation (FVS-SN produces projections in 5 year cycles); see “UTK FVS BSL REV Stand C.xls”. Direct biomass carbon estimates for live trees were output via FVS FFE carbon reports, using Jenkins et al 2003 biomass predictions in metric tons of carbon per acre, matching the calculations applied to the forest inventory measurements.

To improve alignment of FVS FFE outputs with the forest inventory calculations, Jenkins et al 2003-derived FVS FEE live tree biomass projections (solely based on dbh) were adjusted for defect, by applying average percent defect (by stratum) derived from the 2020 inventory data (Table E7; “UTK inventory calcs and stats \*.xlsx”), assuming incidence of defect is constant through the projection period.

**Table E7. Overall percent defect in live above- and belowground tree biomass, derived from 2020 inventory data.**

|  |  |
| --- | --- |
| **Stratum** | **Average % defect ABGB live t CO2/ac** |
| CN | 1.4% |
| CS | 1.3% |
| OR | 0.2% |
| HR\_HW | 0.1% |
| HR\_PI | 0.6% |
| HR\_RG | (Assumed) 0.1%\* |

\*conservatively applying the lowest estimated defect (=higher stocks in the baseline) in the un-inventoried HR\_RG stratum

Standing dead wood was modeled using the Fire and Fuels Extension of FVS (FVS FFE) to produce detailed snag lists for each model cycle. Biomass carbon of each snag was estimated using model output cubic foot volumes of hard and soft components of dead wood, multiplied by dead wood density. Dead wood densities were sourced from the California Air Resources Board database “REF\_SPECIES.xls”, predominately sourced from the USFS Wood Handbook 2010, and incorporated deductions for decay classes corresponding to the hard and soft dead wood components output from the FVS FFE model, and summarized in the table below. Standing dead biomass was converted to carbon applying a carbon fraction of 0.5, and carbon converted to carbon dioxide equivalent (CO2e) applying a conversion factor of 3.664. Detailed standing dead wood calculations are provided in “BSL REV SnagDetxls”. Standing dead wood in un-harvested (SMZ) areas was assumed to be stable.

|  |  |  |
| --- | --- | --- |
| **FVS FFE snag class** | **Deduction** | **Description/justification** |
| soft | 0.8 | Per FVS FFE no branches remain, corresponds with methodology decay class 4 |
| hard | 0.97 | Corresponds to methodology decay class 1; per FVS FFE: “Soft snags are more decayed and are assumed to have 80% of the wood density of hard snags” |

FVS FFE = Rebain et al., 2012

*Harvested wood products*

Step 1:

Long-term storage in wood products was calculated from FVS projections of removals. Projected harvested volumes were broken out into the following categories: softwood sawlog, softwood pulp, hardwood pulp and hardwood sawlog. Pulp/saw breakdowns referenced merchantability standards in the FVS-SN variant (Keyser et al 2008[[8]](#footnote-8)).

Volumes were converted to biomass by applying species-specific specific gravities referenced from the California Air Resources Board database “REF\_SPECIES.xls”. Biomass was converted to carbon applying a carbon fraction of 0.5, and then converting to CO2 equivalent by multiplying by 3.664. Harvest t CO2/acre (before delivery to mill) for each modeled group (i.e. baseline stratum) were summed for four categories: hardwood saw, hardwood pulp, softwood saw and softwood pulp.

Step 2:

Carbon transformed to wood products was estimated applying mill efficiency values referenced from the ARB 2015 forest protocol “Regional Mill Efficiency Data.xls” database[[9]](#footnote-9), for the South Central region (which includes Tennessee), specified below:

|  |  |  |
| --- | --- | --- |
| **Species group** | **sawtimber** | **pulp** |
| softwood | 0.629 | 0.57 |
| hardwood | 0.587 | 0.581 |

Steps 3 and 4:

Transformed carbon was summed across the hardwood/softwood/pulp/sawtimber categories and then distributed among a range of end wood product classes. Distributions of end wood product classes referenced ARB 2015 forest protocol values for the Allegheny & North Cumberland Mountains and Eastern Broadleaf Forest Cumberland Plateau supersections:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Supersections** | **Softwood Lumber** | **Hardwood Lumber** | **Plywood** | **Oriented Strand Board** | **Non-structural Panels** | **Miscellaneous** | **Paper** |
| Allegheny & North Cumberland Mountains | 3.6059% | 68.7654% | 0.0155% | 12.2013% | 4.5936% | 3.3824% | 7.4358% |
| Eastern Broadleaf Forest Cumberland Plateau | 9.8638% | 65.0119% | 0.1648% | 0.0444% | 3.6958% | 14.5833% | 6.6361% |
| area weighted average product class distributions (including only areas subject to harvest in the baseline) | 5.2% | 67.8% | 0.1% | 9.1% | 4.4% | 6.3% | 7.2% |

Wood product amounts retained in storage for 100 years in in-use wood products and landfills were then calculated referencing end wood product class-specific 100-year average storage factors provided in the methodology[[10]](#footnote-10).

Step 5:

Carbon in long-term storage was then summed across in-use wood products and landfills and across modeled groups/baseline strata to produce annual total t CO2 stored in in-use wood products and landfills over 100 years from wood harvested in a given year.

Detailed harvested wood product calculations are provided in “UTK FVS BSL REV Cutlistxls”.

Emissions due to burning logging slash are conservatively assumed in the baseline to be zero. Thus, parameter BSBSL equals zero and the outcome of equation 4 of the methodology, parameter GHGBSL, equals zero.

**Table E8. Projections of live tree, standing dead wood and harvested wood products carbon stocks in the project area in the baseline scenario for the first crediting period from 2020 to 2039. For the live tree and standing dead pools, stocks represent stocks at November 26 of the previous year. Annual average inputs to harvested wood products (HWP) is 14,933.4 t CO2.**

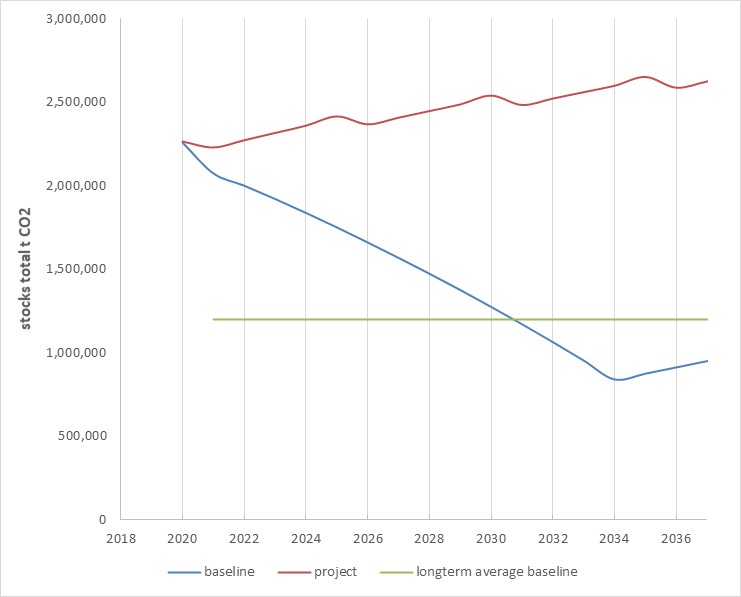
|  |  |  |
| --- | --- | --- |
| **Year** | **Live t CO2/acre** | **Standing dead t CO2/acre** |
| 2020 | 194.6 | 3.9 |
| 2021 | 177.2 | 3.8 |
| 2022 | 169.9 | 3.3 |
| 2023 | 161.9 | 3.0 |
| 2024 | 153.7 | 2.6 |
| 2025 | 145.1 | 2.3 |
| 2026 | 136.2 | 1.9 |
| 2027 | 127.1 | 1.6 |
| 2028 | 117.6 | 1.4 |
| 2029 | 107.9 | 1.3 |
| 2030 | 97.9 | 1.1 |
| 2031 | 87.5 | 1.0 |
| 2032 | 76.9 | 1.0 |
| 2033 | 66.0 | 0.9 |
| 2034 | 54.8 | 0.8 |
| 2035 | 56.5 | 0.7 |
| 2036 | 58.6 | 0.7 |
| 2037 | 60.6 | 0.7 |
| 2038 | 62.6 | 0.7 |
| 2039 | 64.6 | 0.6 |
| 2040 | 66.6 | 0.6 |

From the modeled stocks, we first calculated long‐term average baseline stocking level for the first 20-year crediting period,

1,196,262.3 t CO2, and the change in baseline carbon stocks for each year.

T, project year 11 (ending November 25 2030), is the year that projected stocking levels in the baseline reach the long-term average, after which *ΔCBSL,t* becomes 0; i.e. the crediting baseline is equal to the modeled baseline until the modeled baseline reaches the long-term average, at which point baseline stocks are assumed to be constant (and subsequent change in stocks is equal to zero).

The figure below depicts the projected baseline stocks, average baseline stock for the first crediting period, and projected with-project stocks (see below for derivation of with-project stock projections).



## E2. PROJECT SCENARIO

Ex ante projection of the project scenario is derived and documented in Section E6 below.

## E3. LEAKAGE

Quantification of leakage is limited to market leakage, as no activity-shifting leakage is allowed by the methodology beyond *de minimis* levels. Activity-shifting leakage is precluded through FSC certification.

Note that the University of TN Institute of Agriculture (UTIA) will not be getting “entity-wide” FSC certification, rather certification of the project area. The project area, referred to as the Forest Resources AgResearch and Education Center (FRREC), is one of 10 landholdings in Tennessee and the forest is managed by the FRREC foresters.

Utilization of attestation by the Dean of the University of TN Institute of Agriculture along with, listing of all UTIA landholdings demonstrates that all UTIA landholdings meet activity-shifting leakage requirements set forth in methodology section D6. In addition, the FRREC has timber revenue goals to meet budget requirements. The other landholdings are managed for agricultural research and education purposes and harvesting may occur when the forest dictates the need or when needed for agricultural program purposes. The total forested acres of the other 9 properties (not included in the project) totals approximately 1,800 acres. The FRREC property has achieved FSC certification under The Nature Conservancy’s group FSC certificate.

The above constitutes a deviation that was accepted by ACR on May 5 2021, documented in “20210428acr-methodology-deviation-request-v2-0 UTIATNCWorking WoodlandsD6 leakage RP1 Accepted.doc”

Market leakage was determined by quantifying the merchantable carbon removed in both the baseline and with-project cases. Carbon in longterm storage in in-use wood products and landfills, calculated above, was used to assess relative amounts of “total wood products produced” in the two scenarios. The decrease in wood production relative to the baseline was then calculated and the applicable market leakage discount factor was determined.

Calculation of leakage factors for baseline:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Period** | **Total HWP stored for 100 yrs in the Baseline (tCO2e)** | **Total HWP stored for 100 yrs in the Project Scenario (tCO2e)** | **Decrease in Wood Products as Percentage of Baseline Stocks** | **Applicable Leakage Factor** |
| 2020-2039 | 298,668 | 50,728 | 83% | 0.4 |

## E4. UNCERTAINTY

Per the methodology, “The 90% statistical confidence interval (CI) of sampling can be no more than ±10% of the mean estimated amount of the combined carbon stock across all strata. If the Project Proponent cannot meet the targeted ±10% of the mean at 90% confidence, then the reportable amount shall be the lower bound of the 90% confidence interval.”

Parameter *eBSL,TREE* (6.6%) is derived below from the 2020 inventory data (from which November 26 2019 stocks were estimated).

**Table E9. Live tree statistics from 2020 inventory (trees and saplings combined).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **stratum** | **CN** | **CS** | **HR\_HW** | **HR\_PI** | **OR** |
| mean tCO2/ac | 221.6 | 199.3 | 151.1 | 164.0 | 153.8 |
| variance | 8124.8 | 10274.3 | 3755.1 | 1929.8 | 6096.8 |
| stan dev | 90.1 | 101.4 | 61.3 | 43.9 | 78.1 |
| CV(%) | 0.4 | 51% | 41% | 27% | 51% |
| stan error | 12.0 | 15.8 | 21.7 | 14.6 | 14.5 |
| 90% CI | 20.2 | 26.7 | 41.0 | 27.2 | 24.7 |
| n | 56 | 41 | 8 | 9 | 29 |
| acres | 4362.977 | 3994.3 | 505.5 | 254.3 | 2145.5 |
| stan error | 7.9 |  |  |  |  |
| mean | 196.3 |  |  |  |  |
| 90% CI | 13.0367 |  |  |  |  |
| 90% CI as % of mean | **6.640%** |  |  |  |  |

Parameter *eBSL\_DEAD* (31.0%) is derived below from the 2020 inventory data (from which November 26 2019 stocks were estimated).

**Table E10. Standing dead statistics from 2020 inventory**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **stratum** | **CN** | **CS** | **HR\_HW** | **HR\_PI** | **OR** |
| mean tCO2/ac | 5.1 | 4.4 | 1.0 | 1.66075 | 1.4 |
| variance | 122.0 | 64.6 | 3.5 | 9.8 | 7.1 |
| stan dev | 11.0 | 8.0 | 1.9 | 3.1 | 2.7 |
| CV(%) | 2.2 | 181% | 179% | 189% | 187% |
| stan error | 1.5 | 1.3 | 0.7 | 1.0 | 0.5 |
| 90% CI | 2.5 | 2.1 | 1.2 | 1.9 | 0.8 |
| n | 56 | 41 | 8 | 9 | 29 |
| acres | 4362.977 | 3994.3 | 505.5 | 254.3 | 2145.5 |
| stan error | 0.7 |  |  |  |  |
| mean | 3.915 |  |  |  |  |
| 90% CI | 1.2119 |  |  |  |  |
| 90% CI as % of mean | **30.954%** |  |  |  |  |

Overall uncertainty in the baseline is calculated using equation 10 of the methodology.

Overall uncertainty in the baseline is 6.5%.

Total project uncertainty, *UNC,t*, is calculated using equation 19 of the methodology, and for future monitoring events, where re-measurement of forest carbon stocks has taken place, will use separate baseline, *UNCBSL,t* (value 6.5%) and project, *UNCP,t* (value 6.5% at validation, to be reassessed at each monitoring event), uncertainties.

## E5. REDUCTIONS AND REMOVAL ENHANCEMENTS

Methodology calculations and estimates of net reductions and removals enhancements are detailed in the Table E11 below and in “ACR\_Calcs UTK\*.xls”.

**Table E11. Calculations for the first crediting period. All change values apply to the annual interval beginning November 26 of the previous year (i.e. project year 2020 accounts the change taking place between November 26 2019 and November 25 2020).**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ACR Account Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **project year (stocks at beginning)** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| **ACR Account Year Date** |  | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** |
| **Baseline** |  |  |  |  |  |  |  |  |  |  |  |
| Live Tree CO2 Baseline | 2,211,273.5 | 2,013,616.2 | 1,930,176.5 | 1,840,025.0 | 1,746,045.8 | 1,648,793.0 | 1,547,952.9 | 1,443,830.3 | 1,336,602.8 | 1,225,971.0 | 1,111,963.6 |
| Standing dead CO2 Baseline | 44,093.9 | 42,823.5 | 37,961.9 | 33,757.6 | 29,532.6 | 25,681.9 | 21,755.9 | 18,527.8 | 16,248.3 | 14,664.8 | 12,990.0 |
| HWP Baseline |  | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 |
| sum stocks | 2,255,367.4 | 2,071,373.1 | 1,998,005.3 | 1,918,582.8 | 1,835,312.1 | 1,749,142.0 | 1,659,309.4 | 1,566,892.0 | 1,472,318.4 | 1,375,036.5 | 1,274,287.8 |
| 20yr Avg Baseline |  | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 |
| Year T | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| deltaC baseline |  | -183,994.3 | -73,367.8 | -79,422.4 | -83,270.7 | -86,170.1 | -89,832.7 | -92,417.3 | -94,573.6 | -97,281.8 | -100,748.8 |
| **Project** |  |  |  |  |  |  |  |  |  |  |  |
| Live Tree CO2 Project | 2,211,273.5 | 2,175,932.6 | 2,219,157.8 | 2,262,383.1 | 2,305,608.4 | 2,348,833.6 | 2,301,781.9 | 2,341,244.6 | 2,380,707.3 | 2,420,170.0 | 2,459,632.7 |
| Standing dead CO2 Project | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 |
| Greenhouse gas emission from logging slash burning | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HWP Project | 10,852.6 | 0.0 | 0.0 | 0.0 | 0.0 | 12,076.3 | 0.0 | 0.0 | 0.0 | 0.0 | 13,279.4 |
| sum stocks | 2,266,220.0 | 2,230,879.1 | 2,274,104.4 | 2,317,329.7 | 2,360,554.9 | 2,415,856.5 | 2,368,804.8 | 2,408,267.5 | 2,447,730.2 | 2,487,192.9 | 2,539,935.0 |
| deltaC project |  | -35,340.9 | 43,225.3 | 43,225.3 | 43,225.3 | 55,301.6 | -47,051.7 | 39,462.7 | 39,462.7 | 39,462.7 | 52,742.1 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Total uncertainty |  | 0.06 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Emissions reduction at t |  | 89,192.0 | 69,955.0 | 73,588.0 | 75,897.0 | 84,882.0 | 25,668.0 | 79,128.0 | 80,421.0 | 82,046.0 | 92,094.0 |
| Negative C balance |  | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ERTs Issued at time t |  | 89,192.0 | 69,955.0 | 73,588.0 | 75,897.0 | 84,882.0 | 25,668.0 | 79,128.0 | 80,421.0 | 82,046.0 | 92,094.0 |
| ERTs Transferred In |  | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ERTs Transferred Out |  | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ERTs Retired |  | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tradable Balance at time t |  | 89,192.0 | 69,955.0 | 73,588.0 | 75,897.0 | 84,882.0 | 25,668.0 | 79,128.0 | 80,421.0 | 82,046.0 | 92,094.0 |
| Total Tradable Balance | 0.0 | 89,192.0 | 159,147.0 | 232,735.0 | 308,632.0 | 393,514.0 | 419,182.0 | 498,310.0 | 578,731.0 | 660,777.0 | 752,871.0 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ACR Account Year** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **project year (stocks at beginning)** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** |
| **ACR Account Year Date** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** |
| **Baseline** |  |  |  |  |  |  |  |  |  |  |
| Live Tree CO2 Baseline | 994,551.9 | 873,776.0 | 749,829.4 | 622,471.1 | 642,555.6 | 665,470.3 | 688,384.9 | 711,299.6 | 734,214.3 | 757,129.0 |
| Standing dead CO2 Baseline | 11,797.5 | 10,910.3 | 9,810.0 | 9,038.7 | 8,418.4 | 8,145.6 | 7,872.8 | 7,600.0 | 7,327.1 | 7,054.3 |
| HWP Baseline | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 | 14,933.4 |
| sum stocks | 1,170,617.0 | 1,063,887.4 | 953,773.8 | 840,577.6 | 874,975.3 | 912,550.6 | 950,125.8 | 987,701.1 | 1,025,276.3 | 1,062,851.6 |
| 20yr Avg Baseline | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 | 1,196,262.3 |
| Year T | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| deltaC baseline | -78,025.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project** |  |  |  |  |  |  |  |  |  |  |
| Live Tree CO2 Project | 2,403,762.1 | 2,441,904.9 | 2,480,047.8 | 2,518,190.6 | 2,556,333.5 | 2,492,220.5 | 2,529,564.3 | 2,566,908.0 | 2,604,251.8 | 2,641,595.5 |
| Standing dead CO2 Project | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 | 44,093.9 |
| Greenhouse gas emission from logging slash burning | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HWP Project | 0.0 | 0.0 | 0.0 | 0.0 | 14,520.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| sum stocks | 2,484,064.4 | 2,522,207.2 | 2,560,350.1 | 2,598,492.9 | 2,651,155.7 | 2,587,042.8 | 2,624,386.6 | 2,661,730.3 | 2,699,074.1 | 2,736,417.8 |
| deltaC project | -55,870.7 | 38,142.9 | 38,142.9 | 38,142.9 | 52,662.8 | -64,112.9 | 37,343.8 | 37,343.8 | 37,343.8 | 37,343.8 |
|  |  |  |  |  |  |  |  |  |  |  |
| Total uncertainty | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Emissions reduction at t | 13,292.0 | 22,885.0 | 22,885.0 | 22,885.0 | 31,597.0 | -38,467.0 | 22,406.0 | 22,406.0 | 22,406.0 | 22,406.0 |
| Negative C balance | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -38,467.0 | -16,061.0 | 0.0 | 0.0 | 0.0 |
| ERTs Issued at time t | 13,292.0 | 22,885.0 | 22,885.0 | 22,885.0 | 31,597.0 | 0.0 | 0.0 | 6,345.0 | 22,406.0 | 22,406.0 |
| ERTs Transferred In | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ERTs Transferred Out | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ERTs Retired | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tradable Balance at time t | 13,292.0 | 22,885.0 | 22,885.0 | 22,885.0 | 31,597.0 | 0.0 | 0.0 | 6,345.0 | 22,406.0 | 22,406.0 |
| Total Tradable Balance | 766,163.0 | 789,048.0 | 811,933.0 | 834,818.0 | 866,415.0 | 866,415.0 | 866,415.0 | 872,760.0 | 895,166.0 | 917,572.0 |

## E6. EX-ANTE ESTIMATION METHODS

Live tree carbon stocks in the with-project scenario were projected *ex ante* in FVS-SN for the period 2020 to 2039. Management scenarios were developed with input from University of Tennessee forest managers, and entail predominantly even-aged management via limited clearcuts totaling on average 400 acres harvested every 5 years. The HR\_RG stratum is not harvested. Regeneration was modeled via sprouting.

Projections were annualized using linear interpolation; see “wp live tree proj UT\*.xls” and “wp hwp proj UT\*.xls”. Direct biomass carbon estimates for live trees were output via FVS FFE carbon reports, using Jenkins et al 2003 biomass predictions in metric tons of carbon per acre, again, matching the calculations applied to the forest inventory measurements, and applying defect as described above.

Stocks of standing dead wood are assumed to be constant through the period.

Projections of the with-project scenario are summarized in Table E12 below.

**Table E12. Projections of live tree, standing dead wood and harvested wood products carbon stocks in the project area in the with-project scenario for the first crediting period from 2020 to 2039. For the live tree and standing dead pools, stocks represent stocks at November 26 of the previous year. For harvested wood products (HWP), stocks represent stocks harvested in the annual interval ending November 25 of the corresponding project year.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Live t CO2/acre** | **Standing dead t CO2/acre** | **total HWP t CO2** |
| 2020 | 194.5898 | 3.9 | 10,852.62 |
| 2021 | 191.5 | 3.9 |  |
| 2022 | 195.3 | 3.9 |  |
| 2023 | 199.1 | 3.9 |  |
| 2024 | 202.9 | 3.9 |  |
| 2025 | 206.7 | 3.9 | 12,076.30 |
| 2026 | 202.6 | 3.9 |  |
| 2027 | 206.0 | 3.9 |  |
| 2028 | 209.5 | 3.9 |  |
| 2029 | 213.0 | 3.9 |  |
| 2030 | 216.4 | 3.9 | 13,279.43 |
| 2031 | 211.5 | 3.9 |  |
| 2032 | 214.9 | 3.9 |  |
| 2033 | 218.2 | 3.9 |  |
| 2034 | 221.6 | 3.9 |  |
| 2035 | 225.0 | 3.9 | 14,519.98 |
| 2036 | 219.3 | 3.9 |  |
| 2037 | 222.6 | 3.9 |  |
| 2038 | 225.9 | 3.9 |  |
| 2039 | 229.2 | 3.9 |  |
| 2040 | 232.5 | 3.9 |  |

No significant burning is expected to take place in the project area. Thus, parameter *BSP* equals zero and the outcome of equation 13 of the methodology, parameter *GHGP*, equals zero.

In ex ante calculations of net emission reductions, it is assumed that future inventories achieve overall precision less than +/-10% of the mean with 90% confidence, thus *UNCP* is assumed to be equal to *UNCBSL.*

# F. COMMUNITY & ENVIRONMENTAL IMPACTS

## F1. NET POSITIVE IMPACTS

Net positive impacts of the project are demonstrated referencing the 5 ACR Environmental and Community Impact Assessment Requirements addressed below. Each ACR requirement is listed in italics. The project will further address these requirements through maintenance of FSC Certification. In Addition, the United Nations Sustainable Development Goals are identified and described to which the project impacts are aligned and positively contribute.

1. *An overview of the Project Activity and geographic location.*

The project activity is improved forest management, with UT’s improved forest management practices representing an improvement in carbon storage over higher return, more aggressive management regimes. Management objectives are focused on maintenance, restoration, and enhancement of the biological diversity, water quality, and ecological integrity of the project area forest via implementation and demonstration (the project area is a research forest) of sustainable forest management practices.

The project area is represented by 11,364 forested acres spanning the four counties of Anderson, Franklin, Morgan, and Scott in central and eastern Tennessee. The project area is divided into four separate units: the Highland Rim Forest (861 acres), Oak Ridge Forest (2,145 acres), Cumberland Forest South (3,994 acres) and Cumberland Forest North (4,363 acres).

1. *Applicable laws, regulations, rules, and procedures and the associated oversight institutions.*

There are no state or federal laws that regulate forest management of the project area.

1. *A description of the process to identify community(ies)**and other stakeholders**affected by the project and, as applicable, the community consultation and communications plan.*

Through past landowner field days and special events a historical list of stakeholders and clientele has been complied and will be updated as needed. Stakeholders will be contacted through the UT AgResearch leadership chain of command should conflict or concerns arise. FSC will monitor stakeholder and clientele engagement (i.e. field days, special events, and other documented contact information) as a component of the annual audit.

It should be noted that a core objective of the management plan is to establish and foster positive, viable collaborations with stakeholders and clientele, and to contribute to local economies through management activities and by providing opportunities to the public for compatible nature-based activities like outdoor recreation, education and outreach.

1. *An assessment of the project’s environmental risks and impacts, including factors such as climate change mitigation and adaptation, biodiversity, air quality, water quality, soil quality, and ozone quality, as well as the protection, conservation, or restoration of natural habitats such as forests, grasslands, and wetlands. The assessment shall: 1) identify each risk/impact; 2) categorize the risk/impact as positive, negative, or neutral and substantiate the risk category; 3) describe how any negative impacts will be avoided, reduced, mitigated, or compensated; 4) detail how risks and impacts will be monitored, and how often and by whom; and 5) describe how positive impacts contribute to sustainable development goals (optional).*

| **Risk/impact factor** | **Risk category (positive, negative, neutral)** | **Measure(s) to avoid, reduce, mitigate, or compensate negative impacts** | **Monitoring approach** |
| --- | --- | --- | --- |
| Biodiversity | Positive – Forest management of the project area centers on maintenance, restoration, and enhancement of biological diversity, water quality, and ecological integrity. Forest-dependent species are expected benefit from maintenance of forest cover in a range of seral stages. Restoration of shortleaf pine at the Cumberland Forest and Highland Rim property is aimed at re-establishing this once important forest type, and the species associated with it. | N/A | Identification of key ecological attributes (habitat maintenance, indicator species, etc.) in cooperation with shifting goals and management objectives for short and long-term desired results. Key Economic and Ecological Attributes (KEEA) monitoring requires a full inventory every 10 years to accurately assess and monitor forest conditions. This monitoring will also provide information on rare species and communities.  The project area will also host research initiatives to assess the impacts of forest management on biodiversity. |
| Water Quality | Positive – Forest management of the project area centers on maintenance, restoration, and enhancement of biological diversity, water quality, and ecological integrity.  Maintenance of extensive areas of canopy closure (relative to the baseline scenario) is expected to improve infiltration and reduce overland flow and siltation. | All forest management activities will comply with state of Tennessee BMPs. | Water quality and BMP monitoring will be done at least weekly by UTIA FREC staff during periods of active management, and adaptive management/feedback is monitored continually as a part of the FSC Forest Management Plan. |
| Soil Quality | Neutral – While erosion is always a concern, the High Conservation Value Area (HCV) buffers identified in the FSC forest management plan and riparian buffers address those concerns. There are no areas on the property that would be considered critical to prevent erosion, landslides, avalanches, etc. | N/A | N/A |
| Natural Habitat | Positive – Forest management of the project area centers on maintenance, restoration, and enhancement of biological diversity, water quality, and ecological integrity. Forest habitat will be maintained in a range of seral stages, and shortleaf pine habitat restored at the Highland Rim property. | Areas where concerns arise through monitoring will be visited and checked, and any issues followed up on. | In High Conservation Value Areas where a hands-off approach is appropriate, there will be a less intensive monitoring approach taken, along the following lines. Specific changes in species composition, structure, etc., will be captured in periodic inventories and regular ocular monitoring. HCV areas are also visited during periodic inventory procedures.  For the purposes of this assessment and more generally, UT forest managers and TNC staff regularly consult with biologists from the TN Natural Heritage Program. |
| Cultural and Social Impact |  |  | For the purposes of this assessment and more generally, UT forest managers and TNC staff regularly consult with cultural experts from the TN State Historic Preservation Office. |

1. *For community-based projects, an assessment of the project’s community risks and impacts, including factors such as land and natural resource tenure, land use and access arrangements, natural resource access (e.g., water, fuelwood), food security, land conflicts, economic development and jobs, cultural heritage, and relocation. The assessment shall: 1) briefly describe the process to identify community risks/impacts; 2) identify each risk/impact; 3) categorize the risk/impact as positive, negative, or neutral, and substantiate the risk category; 4) provide detailed information regarding the community stakeholder consultation process (e.g., meeting minutes, attendees), including documentation of stakeholder comments and concerns and how those are addressed; 5) provide evidence of Free, Prior and Informed Consent for the Project Activity, as applicable; 6) provide evidence of no relocation or resettlement (voluntary or involuntary), as applicable; 7) describe how any negative project impacts will be avoided, reduced, mitigated, or compensated; 8) detail how risks/impacts will be monitored, and how often and by whom; 9) describe the mechanism for ongoing communications with the community and grievance mechanisms, as applicable; and 10) de-scribe how positive impacts contribute to sustainable development goals (optional).*

The project is a not a community-based project.

1. *Sustainable Development Impacts* (*sdgs.un.org/goals)*

Goal 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all)- The University of Tennessee will incorporate the project into teaching curricula and establish a Climate Smart Forestry Fund to train students in sustainable forestry and carbon offsetting technical and vocational skills, translating to valuable new services that are currently scarce in the workforce.

Goal 6 (Ensure availability and sustainable management of water and sanitation for all)- The forests lie in the headwaters of the Tennessee River and Cumberland River watersheds. A rigorous and certified forest management plan will protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, and lakes.

Goal 13 (Take urgent action to combat climate change and its impacts)- Healthy, diverse forests like these can better resist the impacts of a changing climate, while also mitigating rising temperatures through enhanced carbon sequestration and storage.

Goal 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss)- By integrating ecosystem and biodiversity values into forest management plans  
and certifying the forests under the Conservancy’s FSC® certificate, the University will  
ensure the conservation, restoration, and sustainable use of mountain forest ecological  
systems and their services.

## F2. STAKEHOLDER COMMENTS

UT FRREC managers have good relations with adjacent landowners and consult regularly. Mangers also have good relations and communicate regularly with regional state, federal and private forest land managers. The Arboretum is active in educational pursuits with stakeholders. Managers hold educational outreach and field day events on an annual basis. As a part of the Forest Stewardship Council (FSC) certification, letters were sent to area tribes and state historic officers soliciting any input on sites or relative management. In addition through this unique partnership with TNC, there is significant engagement across a wide range of partners whose input will be considered when making management decisions.

Through past landowner field days and special events, a historical list of stakeholders and clientele has been complied and will be updated as needed. Stakeholders will be contacted through the UT AgResearch leadership chain of command should conflict or concerns arise. FSC will monitor stakeholder and clientele engagement (i.e. field days, special events, and other documented contact information) as a component of the annual audit.

# G. OWNERSHIP AND TITLE

## G1. PROOF OF TITLE

Land title for the project area is housed at the University of Tennessee and made available during project validation.

## G2. CHAIN OF CUSTODY

Not Applicable – no offsets have been bought or sold previously, nor has the project entered into any forward option contracts.

## G3. PRIOR APPLICATION

Not Applicable – the project proponent has not applied for GHG emission reduction credits through any other GHG emissions trading system or program.

# H. PROJECT TIMELINE

## H1. START DATE

The project start date is November 26 2019, marked by the date that UT and TNC signed an agreement to develop forested properties owned and managed by UT as a climate mitigation project under the American Carbon Registry. Conformance with ACR Forest Carbon Project Standard Requirements is demonstrated in Section A3 above.

## H2. PROJECT TIMELINE

Project timeline is elaborated in Table H1 below.

**Table H1. Schedule of project activities**

|  |  |  |
| --- | --- | --- |
| **Project activity** | **Date** | **Source/Notes** |
| Project start date and start of the crediting period | November 26 2019 | Date of agreement between UT and TNC |
| Forest carbon inventory | March-April 2020 |  |
| Validation and registration of the project | June 2022 |  |
| First monitoring | November 26 2019-August 21 2020 |  |
| First verification | June 2022 |  |
| Periodic monitoring and verification | 2020-2059 | Every 5 years or less, or at request for ERT issuance |
| End date of first project crediting period | November 25 2039 |  |
| Second crediting period | November 26 2039 – November 25 2059 | Baseline re-evaluated in November 2039 |
| End date of project term | November 25 2059 |  |

1. <https://www.tn.gov/content/dam/tn/agriculture/documents/forestry/AgForBMPs.pdf> [↑](#footnote-ref-1)
2. <https://www.sciencebase.gov/catalog/item/5a96cdc8e4b06990606c4d82> [↑](#footnote-ref-2)
3. USFS Wildland Fire Assessment System <https://www.wfas.net/index.php/fire-danger-rating-fire-potential--danger-32> Project area region typically categorized under low fire danger rating. Also classified as low by Dillon, G.K.; J. Menakis; and F. Fay. 2015. [Wildland Fire Potential: A Tool for Assessing Wildfire Risk and Fuels Management Needs. (link is external)](http://www.treesearch.fs.fed.us/pubs/49429) pp 60-76 In Keane, R. E.; Jolly, M.; Parsons, R.; and Riley, K. Proceedings of the large wildland fires conference; May 19-23, 2014; Missoula, MT. Proc. RMRS-P-73. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 345 p. No fires >1000ac have occurred in this region in the past 12 months, Southern Area Coordinator Center <https://gacc.nifc.gov/sacc/> [↑](#footnote-ref-3)
4. In the case of the project area, the most relevant and potentially damaging forest pest/disease would be southern pine beetle and/or emerald ash borer. 1-10% of the county is at high risk of loss due to pine beetle <https://foresthealth.fs.usda.gov/nidrm/>. No major epidemics of southern pine beetle have occurred in the regions since the 1999-2001 outbreak. Ash is a minimal component of overall forest carbon stock. [↑](#footnote-ref-4)
5. <https://www.tn.gov/content/dam/tn/agriculture/documents/forestry/AgForBMPs.pdf> [↑](#footnote-ref-5)
6. <https://www.arb.ca.gov/cc/capandtrade/protocols/usforest/usforestprojects_2015.htm> [↑](#footnote-ref-6)
7. Jenkins, J.C., Chojnacky, D.C., Heath, L.S. and R.A. Birdsey. 2003. National-scale biomass estimators for United States tree species. Forest Science 49:12-35 [↑](#footnote-ref-7)
8. Keyser, Chad E., comp. 2008 (revised May 8, 2012). Southern (SN) Variant Overview – Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 70p. [↑](#footnote-ref-8)
9. Sourced at: https://www.arb.ca.gov/cc/capandtrade/protocols/usforest/usforestprojects\_2015.htm [↑](#footnote-ref-9)
10. Sourced from Smith JE, Heath LS, Skog KE, Birdsey RA (2006) Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States. In: General Technical Report NE-343 (eds Usdafs), PP. 218. USDA Forest Service, Washington, DC, USA. [↑](#footnote-ref-10)