Appendix to TNC - Chestnut Mountain Improved Forest Management Project

Monitoring report:

December 6, 2018 – December 5, 2019

The Nature Conservancy

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A. IMPLEMENTATION SUMMARY

Over the current monitoring period, the project has maintained certification under the Forest Stewardship Council (FSC). No harvesting has taken place during the monitoring period. A prescribed burn was implemented on 37 acres of the Shortleaf Regen stratum in stands H and I in 2019. Biomass in the above- and below-ground carbon pools was not affected by the burn.

B. GHG EMISSION REDUCTIONS AND REMOVALS

B1. CARBON STOCKS

Live tree biomass

For the Cove HW, SMZ and Upland HW strata, carbon stock estimates for the December 5, 2019 project monitoring date were modeled from the Dec 2015-Mar 2016 inventory data applying tree level annual diameter growth rates (* 4 growing seasons) derived using the US Forest Service Forest Vegetation Simulator (FVS) Southern (SN) variant version 2531 (October 2018) (see "ChesMt2015nomgt.key"). These are the same growth rates used to project the inventory data to the June 2018 start data (* 2.5 growing seasons) and to the end of the first monitoring period in December 2018 (* 3 growing seasons). The Shortleaf Regen stratum was modeled separately with FVS-SN using base inventory data measured in July 2018 and incorporating modeled shortleaf pine planting on a 10' * 10' uniform spacing (436 stems per acre) matching planting carried out by TNC in 2018; the Shortleaf Regen model projection used in this monitoring period is the same projected in the ex-ante with-project scenario in the project GHG Plan.

The FVS-SN model was calibrated to the project area entering the FVS location code 80812 (Clinch District, George Washington/Jefferson NF), Ecoregion code 223Eb (Eastern Karst Plain) and site index, determined using the NRCS Web Soil Survey database as applied in the original GHG Plan.

Table B1. Summary of Site Index for each stratum in the Chestnut Mountain 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	% Area Available Soil Data
Cove Hardwood	66	Virginia Pine	56
Streamside Management Zone (SMZ)	68	White Oak	87
Upland Hardwood	68	White Oak	96

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.

The grow-forward procedure for the Cove HW, SMZ and Upland HW strata is outlined below.

1. Dec 2015-Mar 2016 inventory data were entered into FVS-SN and grown for 5 years with no management (see "ChesMt2015nomgt.key" and "ChesMt_Database.mdb").
2. For each live tree (ascribed a unique identifier), annual diameter growth was derived assuming linear growth during the 5-year projection interval (i.e. for dbh, annual growth calculated as dbh at end of 5-year interval *minus* dbh at beginning of 5-year interval, reported in the FVS Treelist output, *divided by* 5).
3. For each live tree, diameter data from the Dec 2015-Mar 2016 inventory were grown referencing the annual rates derived in step 2 above, adding 4 years annual growth (i.e. 4 growing seasons) to the Dec 2015-Mar 2016 measurement value.
4. Initial carbon stocks were recalculated using the grown data. No harvests or significant disturbances took place in these strata during the intervening period. Diameters of standing dead trees were assumed to be constant through the period.

The grow-forward procedure for the Shortleaf Regen stratum:

1. June 2018 inventory data from the Shortleaf Regen stratum were entered into FVS-SN and grown for 5 years including shortleaf pine plantings that occurred in 2018 at 436 trees/acre (see "ChesMt2018wp_rev2.key" and "ChesMt2018rev_Database.mdb").
2. Total estimated carbon for live trees in this stratum was calculated using the FFE extension in FVS.
3. Live-tree growth was assumed to be linear and annual growth rates were derived by dividing the difference in carbon stocks in year 2023 from stocks in 2018 and dividing by 5.
4. One year of estimated growth was added to the 2018 modeled inventory for the stratum to determine the 2019 live-tree stocks (see "wp live tree proj ChesMt 2019.xlsx").

Results for above- and belowground (live and dead) tree biomass are presented in Table B2; calculations are documented in "Chestnut Mtn inventory GROWN Dec2019.xls". Dead wood is constant for the reporting period.

Table B2. Summary of model results.

	Cove HW	ShortleafRegen	SMZ	Upland HW
Mean live ABGB tCO2/ac	186.2	15.3	180.4	185.0
Mean dead ABGB tCO2/ac	1.3	0.9	2.5	9.6
n	14	4	21	55

Estimated total stock in live and dead trees at the project monitoring date of December 5, 2019 is 1,017,395.8 t CO2 = (176.8 live t CO2/ac + 6.3 dead t CO2/ac) * 5,556.2 acres.

Table B3. Summary of estimates of live- and dead-tree carbon stocks in the project area in the project scenario at the end of the monitoring period December 6, 2018 to December 5, 2019. For harvested wood products (HWP), stocks represent stocks harvested in the interval from December 5, 2018 to December 5, 2019.

Year	total live t CO2	Total snags t CO2	total HWP t CO2
Dec-2018	982,573.8	34,822.1	0

No burning of any kind was performed in the course of management in the project area during the monitoring period, confirmed via surveillance by land managers. Thus, parameter BS_P equals zero and the outcome of equation 13 of the methodology, parameter GHG_P, equals zero.

B2. LEAKAGE

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

Market leakage was determined by quantifying the merchantable carbon removed in both the baseline and with-project cases. Carbon in long-term 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. Management openings envisioned in the project scenario are anticipated to produce insignificant commercial wood volumes, and for simplicity, the with-project scenario is modeled as no (insignificant)

harvest, i.e. zero. The result, in application to the leakage assessment, is unambiguously conservative. The decrease in wood production relative to the baseline was then calculated and the applicable market leakage discount factor was determined.

Table B4. Calculation of leakage factors for December 6, 2018 to December 5, 2019.

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
2019	7,351	0	100%	0.4

B3. 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."

Uncertainty in live tree and dead wood pools was based on the original Dec 2015-Mar 2016 inventory. Overall uncertainty in the baseline was calculated using equation 10 of the methodology in the original GHG Plan,

$$UNC_{BSL} = \sqrt{((C_{BSL,TREE} * e_{BSL,TREE})^2 + (C_{BSL,DEAD} * e_{BSL,DEAD})^2 + (C_{BSL,HWP} * e_{BSL,TREE})^2 + (GHG_{BSL} * e_{BSL,TREE})^2)} / (C_{BSL,TREE} + C_{BSL,DEAD} + C_{BSL,HWP} + GHG_{BSL})$$

where $C_{BSL,TREE}$ is the live tree carbon stock at the start date, $C_{BSL,DEAD}$ is the dead wood carbon stock at the start date and $C_{BSL,HWP}$ is the twenty-year average stock of carbon in long term storage in wood products. Emissions due to burning logging slash are conservatively assumed in the baseline to be zero, thus parameter GHG_{BSL} equals zero.

Overall uncertainty in the baseline is 5.9%.

Total project uncertainty in year 2019, $UNC_{P,t}$, is 5.7%, calculated using equation 19 of the methodology.

B4. REDUCTIONS AND REMOVAL ENHANCEMENTS

Methodology calculations and estimates of net reductions and removals enhancements are detailed in the Table B5 below and in "ACR_Calcs ChesMt Dec2019 MonitoringReport.xlsx".

Table B5. Calculations for the monitoring period June 5, 2018 to Dec 5, 2018

ACR Account Year	**0**	**1**	**2**
year (stocks at beginning)	**2018**	**2019**	**2020**
ACR Account Year Date		**2018**	**2019**
Baseline			
Live Tree CO2 Baseline	943,779.0	718,835.7	615,799.9
Standing dead CO2 Baseline	34,822.1	28,953.7	23,085.4
HWP Baseline		7,351.3	7,351.3
sum stocks	978,601.1	755,140.7	653,588.0
20yr Avg Baseline		268,496.0	268,496.0
Year T	0.0	0.0	0.0
deltaC baseline		-223,460.3	-101,552.7
Project			
Live Tree CO2 Project	943,779.0	956,502.2	982,573.8
Standing dead CO2 Project	34,822.1	34,822.1	34,822.1
Greenhouse gas emission from logging slash burning	0.0	0.0	0.0
HWP Project	0.0	0.0	0.0
sum stocks	978,601.1	991,324.3	1,017,395.8
deltaC project		12,723.3	26,071.5
Total uncertainty		0.0543	0.0470
leakage		94,473.43	51,049.69
risk buffer		25,508.00	13,784.00
Emissions reduction at t		141,710.0	76,574.0
Negative C balance		0.0	0.0
ERTs Issued at time t		141,710.0	76,574.0
ERTs Transferred In		0.0	0.0
ERTs Transferred Out		0.0	0.0
ERTs Retired		0.0	0.0
Tradable Balance at time t		141,710.0	76,574.0
Total Tradable Balance	0.0	141,710.0	218,284.0

Emission reductions and removal enhancements were calculated applying equation 20 of the methodology as the change in with-project stocks minus the change in baseline stocks multiplied by a market leakage discount and uncertainty discount. The minimum risk buffer contribution applied a Minimum Buffer Percentage of 18%, derived from the 2018 project risk assessment ACR Risk Tool. *Note that the buffer pool contribution will be transferred from another project.* The results of these calculations are summarized in Table B6 below.

Table B6. Estimates of emission reductions by vintage and cumulative emission reductions for the monitoring period December 6, 2018 to December 5, 2019.

Reporting Period t	**1**	**2**	**2**
Vintage Year	**2018**	**2018**	**2019**
Vintage Start Date	5-Jun-18	6-Dec-18	1-Jan-19
Vintage End Date	5-Dec-18	31-Dec-18	5-Dec-19
$RP_{CAL,t}$ (Days)	184	365	365
CAL_t (Days)	184	26	339
Net GHG emission reductions by vintage (t CO2)	116,202	4,473	58,318
Buffer emissions by vintage (t CO2)	25,508	982	12,801
Total Credits Issued (t CO2)	141,710	5,455	71,119
Cumulative Emissions Reductions earned (t CO2)	141,710	147,165	218,284