Forest Project Protocol

For Board Approval
Version 3.2
August 20, 2010

Acknowledgements

Staff

Derik Broekhoff	Climate Action Reserve
John Nickerson	Climate Action Reserve
Heather Raven	Climate Action Reserve

Work Group

Name	Organization
Connie Best	The Pacific Forest Trust
Dave Bischel	California Forestry Association
Louis Blumberg	The Nature Conservancy
Steve Brink	California Forestry Association
Ann Chan	The Pacific Forest Trust
Florence Daviet	World Resources International
George Gentry	California Board of Forestry
Bruce Goines	United States Forest Service
Katie Goslee	Winrock International
Greg Giusti	University of California Extension
Sterling Griffin	Scientific Certification Systems
Caryl Hart	California State Parks
Eric Holst	Environmental Defense Fund
Robert Hrubes	Scientific Certification Systems
Nick Martin	Winrock International
Ed Murphy	Sierra Pacific Industries
Mark Nechodom	United States Forest Service
Jeanne Panek	California Air Resources Board
Michelle Passero	The Nature Conservancy
Tim Pearson	Winrock International
Tim Robards	California Department of Forestry and Fire Protection
Emily Russell Roy	The Pacific Forest Trust
Bob Rynearson	W.M Beaty & Associates
Gary Rynearson	Green Diamond Resources
Jayant Sathaye	University of California, Berkeley
Kimberly Todd	United States Environmental Protection Agency
Doug Wickizer	California Department of Forestry and Fire Protection

Technical Support

Nancy Budge	QB Consulting
Jordan Golinkoff	The Conservation Fund

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Abbreviations and Acronyms

C	Carbon
CH_4	Methane
CO_2	Carbon dioxide
CRT	Climate Reserve Tonne
FIA	Forest Inventory Assessment [http://fia.fs.fed.us/program-features/rpa/]
FPP	Forest Project Protocol
FRAP	CalFire Fire and Resource Assessment Program
GHG	Greenhouse gas
lb	Pound
IFM	Improved Forest Management
N_2O	Nitrous oxide
PF	Professional Forester, in the case of California a 'Registered Professional Forester'
PIA	Project Implementation Agreement
Reserve	Climate Action Reserve
RPF	Registered Professional Forester, a person registered to practice professional forestry in California
USFS	United States Forest Service

1 Introduction

The Forest Project Protocol (FPP) provides requirements and guidance for quantifying the net climate benefits of activities that sequester carbon on forestland. The protocol provides project eligibility rules; methods to calculate a project's net effects on greenhouse gas (GHG) emissions and removals of CO_2 from the atmosphere ("removals"); procedures for assessing the risk that carbon sequestered by a project may be reversed (i.e. released back to the atmosphere); and approaches for long term project monitoring and reporting. The goal of this protocol is to ensure that the net GHG reductions and removals caused by a project are accounted for in a complete, consistent, transparent, accurate, and conservative manner and may therefore be reported to the Climate Action Reserve (Reserve) as the basis for issuing carbon offset credits (called Climate Reserve Tonnes, or CRTs).

The Reserve is a national offsets program working to ensure integrity, transparency and financial value in the North American carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emissions reduction projects in North America; issuing carbon offset credits known as CRTs generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emissions reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market.

The Climate Action Reserve operates as a program under the similarly named nonprofit organization. Two other programs, the Center for Climate Action and the California Climate Action Registry, also operate under the Climate Action Reserve.

Only those Forest Projects that are eligible under and comply with the FPP may be registered with the Reserve. Section 10 of this protocol provides requirements and guidance for verifying the performance of project activities and their associated GHG reductions and removals reported to the Reserve.

1.1 About Forests, Carbon Dioxide, and Climate Change

Forests have the capacity to both emit and sequester carbon dioxide (CO_2), a leading greenhouse gas that contributes to climate change. Trees, through the process of photosynthesis, naturally absorb CO_2 from the atmosphere and store the gas as carbon in their biomass, i.e. trunk (bole), leaves, branches, and roots. Carbon is also stored in the soils that support the forest, as well as the understory plants and litter on the forest floor. Wood products that are harvested from forests can also provide long term storage of carbon.

When trees are disturbed, through events like fire, disease, pests or harvest, some of their stored carbon may oxidize or decay over time releasing CO_2 into the atmosphere. The quantity and rate of CO_2 that is emitted may vary, depending on the particular circumstances of the disturbance. Forests function as reservoirs in storing CO_2. Depending on how forests are managed or impacted by natural events, they can be a net source of emissions, resulting in a decrease to the reservoir, or a net sink, resulting in an increase of CO_2 to the reservoir. In other words, forests may have a net negative or net positive impact on the climate.

Through sustainable management and protection, forests can also play a positive and significant role to help address global climate change. The Reserve's FPP is designed to

address the forest sector's unique capacity to sequester, store, and emit CO_2 and to facilitate the positive role that forests can play to address climate change.

1.2 About Version 3.2 of the Forest Project Protocol

Version 3.2 of the Forest Project Protocol (September 2009) was the result of over 20 months of discussion by a dedicated workgroup. The multi-stakeholder workgroup began meeting with the explicit task of updating the forest protocols to:

- Allow greater landowner participation, particularly publicly-owned lands and industrial working forests.
- Make improvements to the protocol's clarity, accuracy, conservativeness, environmental integrity, and cost-effectiveness (where doing so does not infringe on other principles).

Additionally, Version 3.0 was designed so that it can be applied to projects outside the state of California.

The Reserve uses a rigorous, transparent, and comprehensive process for developing all of its protocols, focusing on accurate and conservative accounting to ensure that credits are issued only for GHG reductions and removals that are real, permanent, additional, verifiable, and enforceable by contract. The Reserve may update the FPP from time to time to reflect new scientific findings or policy decisions. For additional information about the update process and further news on future updates, please visit the Reserve website at www.climateactionreserve.org.

The Reserve continues to fully support projects registered under previous versions of the forest protocol and strongly believes that the GHG reductions and removals quantified for such projects will continue to meet the highest standards today and into the future. Forest Projects that are registered under previous versions of the FPP may continue to be verified under the version of the FPP in place at the time they were registered.

Forest Project Aggregation Rules

As part of its efforts to encourage greater participation by forest landowners in the Climate Action Reserve's carbon offset program, the Reserve has developed rules and procedures under which smaller forest projects may be aggregated. The goal of aggregation is to alleviate transaction costs for individual landowners, while upholding the Reserve's standards for quantification certainty and integrity. Allowing smaller projects to register as part of a group, or "aggregate," can help reduce costs by enabling economies of scale and supporting the marketing of offset credits at volume. Rules for aggregating Forest Projects are contained in a separate document, the *Climate Action Reserve Guidelines for Aggregating Forest Project*s, available on the Reserve's website at http://www.climateactionreserve.org/how/protocols/adopted/forest/current/.

2 Forest Project Definitions and Requirements

For the purposes of the FPP, a Forest Project is a planned set of activities designed to increase removals of CO_2 from the atmosphere, or reduce or prevent emissions of CO_2 to the atmosphere, through increasing and/or conserving forest carbon stocks.

A glossary of terms related to Forest Projects is provided in Section 11 of this protocol. Throughout the protocol, important defined terms are capitalized (e.g. "Reforestation Project").

2.1 Project Types

The Reserve will register the following types of Forest Project activities.

2.1.1 Reforestation

A Reforestation Project involves restoring tree cover on land that is not at optimal stocking levels and has minimal short-term (30-years) commercial opportunities. A Reforestation Project is only eligible if:

1. The project involves tree planting, or removal of impediments to natural reforestation, on land that:
    a. Has had less than 10 percent tree canopy cover for a minimum of 10 years; or
    b. Has been subject to a Significant Disturbance that has removed at least 20 percent of the Project Area's live biomass in trees.
2. No rotational harvesting of reforested trees or any harvesting of pre-existing carbon in live trees occurs during the first 30 years after the project start date unless such harvesting is needed to prevent or reduce an imminent threat of disease. Such harvesting may only occur if the Forest Owner provides the Reserve with a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the harvesting is necessary to prevent or mitigate disease.
3. The tree planting, or removal of impediments to natural reforestation, does not follow a commercial harvest of healthy live trees that has occurred in the Project Area within the past 10 years, or since the occurrence of a Significant Disturbance, whichever period is shorter.
4. The project does *not* employ broadcast fertilization.
5. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

Reforestation Projects may be eligible on both private and public lands.

2.1.2 Improved Forest Management

An Improved Forest Management Project involves management activities that maintain or increase carbon stocks on forested land relative to baseline levels of carbon stocks, as defined in Section 6.2 of this protocol. An Improved Forest Management Project is only eligible if:

1. The project takes place on land that has greater than 10 percent tree canopy cover.
2. The project employs natural forest management practices, as defined in Section 3 of this protocol.
3. The project does *not* employ broadcast fertilization.
4. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

Eligible management activities may include, but are not limited to:

- Increasing the overall age of the forest by increasing rotation ages.
- Increasing the forest productivity by thinning diseased and suppressed trees.
- Managing competing brush and short-lived forest species.
- Increasing the stocking of trees on understocked areas.
- Maintaining stocks at a high level.

Improved Forest Management Projects may be eligible on both private and public lands.

2.1.3 Avoided Conversion

An Avoided Conversion Project involves preventing the conversion of forestland to a non-forest land use by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership. An Avoided Conversion Project is only eligible if:

1. The Forest Owner can demonstrate that there is a significant threat of conversion of project land to a non-forest land use by following the requirements for establishing the project's baseline in Section 6.3 of this protocol.
2. The project does *not* employ broadcast fertilization.
3. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

An Avoided Conversion Project may involve tree planting and harvesting as part of the project activity.

Avoided Conversion Projects are eligible only on lands that are privately owned prior to the project start date.

2.2 Forest Owners

A Forest Owner is a corporation or other legally constituted entity, city, county, state agency, individual(s), or a combination thereof that executes the Project Implementation Agreement (see Section 3.5). Generally, a Forest Owner is the owner in fee of the property involved in a Forest Project. In some cases, one entity may be the owner in fee while another entity may have an interest in the trees or the timber on the property, in which case the Reserve will make a determination as to whether both entities are required to execute the Project Implementation Agreement and thereby collectively be considered the Forest Owner.

In some cases, the Reserve may determine that an entity or individual that is not the owner in fee nonetheless does have a complete and perpetual interest in the trees on the property that allows for complete management of the trees and sufficient access rights to the property, such that it is the appropriate entity to execute the Project Implementation Agreement. In these cases, such an entity or individual may be defined as the Forest Owner, on the condition that it makes additional contributions of CRTs to the Reserve's Buffer Pool (see Section 7.2). The assignment provisions of the Project Implementation Agreement explain when and how a party to the agreement may assign its obligations thereunder.

The Forest Owner is responsible for undertaking a Forest Project and registering it with the Reserve, and is ultimately responsible for all Forest Project reporting and attestations. The Forest Owner may, however, engage an independent third-party project developer to assist or consult with the Forest Owner and to designate and implement the Forest Project. All

information submitted to the Reserve on behalf of the Forest Owner shall reference the Forest Owner, who is ultimately responsible for the accuracy and completeness of the information submitted.

3 Eligibility Rules and Other Requirements

In addition to the definitions and requirements described in Section 2, Forest Projects must meet several other criteria and conditions to be eligible for registration with the Reserve, and must adhere to certain requirements related to their duration and crediting periods.

3.1 Additionality

The Reserve strives to register only projects that yield surplus GHG emission reductions and removals that are additional to what would have occurred in the absence of a carbon offset market (i.e. under "Business As Usual"). For a general discussion of the Reserve's approach to determining additionality, see the Reserve's Program Manual (available at http://www.climateactionreserve.org/how/program/program-manual/).

Forest Projects must satisfy the following tests to be considered additional:

1. *Legal requirement test*. Forest Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from compliance with any federal, state, or local law, statute, rule, regulation, or ordinance. Forest Projects must also achieve GHG reductions and removals above and beyond any GHG reductions or removals that would result from compliance with any court order or other legally binding mandates including management plans (such as Timber Harvest Plans) that are required for government agency approval of harvest activities. Legally binding mandates also include conservation easements or deed restrictions, except where such conservation easements or deed restrictions have been enacted in support of the Forest Project, as described in Section 3.6.
2. *Performance test*. Forest Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from engaging in Business As Usual activities, as defined by the requirements described below (Section 3.1.2).

3.1.1 Legal Requirement Test

The legal requirement test is satisfied if the following requirements are met, depending on the type of Forest Project.

3.1.1.1 Reforestation Projects

At the Forest Project's first verification, the Forest Owner must sign the Reserve's Attestation of Voluntary Implementation form indicating that the project's reforestation activities are not legally required (as defined above) and were not legally required at the time of the project's start date.

Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.1 of this protocol.

3.1.1.2 Improved Forest Management Projects

Each time the Forest Project is verified, the Forest Owner must sign the Reserve's Attestation of Voluntary Implementation form indicating that the Forest Project is not legally required (as defined above). For the purposes of the attestation, the "Project" is defined as maintaining onsite carbon stocks at their current levels (at the time the attestation is signed) for at least 100 years.

Modeling of the project's baseline carbon stocks must reflect all legal constraints in effect at the time of the project's start date, as required in Section 6.2 of this protocol.

3.1.1.3 Avoided Conversion Projects

At the Forest Project's first verification, the Forest Owner must sign the Reserve's Attestation of Voluntary Implementation form indicating that the Forest Project's planned forest conservation activities are not legally required (as defined above) and were not legally required at the time of the project's start date.

Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.3 of this protocol.

The Forest Owner must provide documentation demonstrating that the type of anticipated land use conversion is legally permissible. Such documentation must fall into at least one of the following categories:

1. Documentation indicating that the current land use policies, including zoning and general plan ordinances, and other local and state statutes and regulations, permit the anticipated type of conversion.
2. Documentation indicating that the Forest Owner has obtained all necessary approvals from the governing county to convert the Project Area to the proposed type of non-forest land use (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.)
3. Documentation indicating that similarly situated forestlands within the project's Assessment Area were recently able to obtain all necessary approvals from the governing county, state, or other governing agency to convert to a non-forest land use (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.)

3.1.2 Performance Test

The performance test is satisfied if the following requirements are met, depending on the type of Forest Project:

3.1.2.1 Reforestation Projects

A Reforestation Project that occurs on land that has had less than 10 percent tree canopy cover for at least 10 years automatically satisfies the performance test.

A Reforestation Project that occurs on land that has undergone a Significant Disturbance satisfies the performance test if:

1. The Forest Project corresponds to a scenario in Appendix E, Table E.1, indicating that it is "eligible" (as determined by the guidance in Appendix E); or
2. The Forest Project occurs on a type of land for which the Forest Owner has not historically engaged in or allowed timber harvesting. (Examples of such land include municipal or state parks.)

3.1.2.2 Improved Forest Management Projects

An Improved Forest Management Project automatically satisfies the performance test. (Project activities are considered additional to the extent they produce GHG reductions and/or removals in excess of those that would have occurred under a Business As Usual scenario, as defined by the baseline estimation requirements in Section 6.2.1.)

3.1.2.3 Avoided Conversion Projects

An Avoided Conversion Project satisfies the performance test if the Forest Owner provides a real estate appraisal for the Project Area (as defined in Section 4) indicating the following:

1. *The Project Area is suitable for conversion*. The appraisal must clearly identify the highest value alternative land use for the Project Area and indicate how the physical characteristics of the Project Area are suitable for the alternative land use.
    a. At a minimum, where conversion to commercial, residential, or agricultural land uses is anticipated, the appraisal must indicate that the slope of Project Area land does not exceed 40 percent.
    b. Where conversion to agricultural land use is anticipated, the appraisal must provide:
        i. Evidence of soil suitability for the type of expected agricultural land use.
        ii. Evidence of water availability for the type of expected agricultural land use.
    c. Where conversion to mining land use is anticipated, the appraisal must provide evidence of the extent and amount of mineral resources existing in the Project Area.
    d. The appraisal must identify specific portions of the Project Area suitable for the identified alternative land use. (For example, an appraisal that identified a golf course as an alternative land use must specify the approximate acres suitable for fairways, greens, clubhouses, and outbuildings.)
2. *The alternative land use for the Project Area has a higher market value than forestland*. The appraisal for the property must demonstrate that the fair market value of the anticipated alternative land use for the Project Area is at least 40 percent greater than the value of the current forested land use.

Where conversion to residential, commercial, or recreational land uses is anticipated, the appraisal must also describe the following information:

1. The proximity of the Project Area to metropolitan areas
2. The proximity of the Project Area to grocery and fuel services and accessibility of those services
3. Population growth within 180 miles of the Project Area

The appraisal must be conducted in accordance with the Uniform Standards of Professional Appraisal Practice[1] and the appraiser must meet the qualification standards outlined in the Internal Revenue Code, Section 170 (f)(11)(E)(ii).[2]

3.2 Project Start Date

The start date of a Forest Project is the date on which an activity is initiated that will lead to increased GHG reductions or removals relative to the Forest Project's baseline. The following actions identify the project start date for each project type:

[1] The Uniform Standards of Professional Appraisal Practice may be accessed at: http://commerce.appraisalfoundation.org/html/2006%20USPAP/toc.htm

[2] Section 170 (f)(11)(E) of the Internal Revenue Code defines a qualified appraiser as "an individual who -
(I) has earned an appraisal designation from a recognized professional appraiser organization or has otherwise met minimum education and experience requirements set forth in regulations prescribed by the Secretary,
(II) regularly performs appraisals for which the individual receives compensation, and
(III) meets such other requirements as may be prescribed by the Secretary in regulations or other guidance."

- For a Reforestation Project, the action is the planting of trees, the removal of impediments to natural regeneration, or site preparation for the planting of trees, whichever comes first.
- For an Improved Forest Management Project, the action is initiating forest management activities that increase sequestration and/or decrease emissions relative to the baseline, or transferring the Project Area to public ownership (see further guidance below).
- For an Avoided Conversion Project, the action is committing the Project Area to continued forest management and protection through recording a conservation easement with a provision to maintain the Project Area in forest cover or transferring the Project Area to public ownership where the Project Area will be maintained in forest cover.

Until April 30, 2010 the Reserve will list projects with start dates as early as January 1, 2001. After April 30, 2010, projects must be listed on the Reserve within 6 months of their project start date.[3]

An Improved Forest Management project's start date must be linked to a discrete, verifiable action that delineates a change in practice relative to the project's baseline. Possible actions include:

- Recordation of a conservation easement on the Project Area. The project start date is the date the easement was recorded.
- Transferring of property ownership (to a public or private entity). The project start date is the date of property transfer.
- Submitting the project to the Reserve.[4] The project start date is the date of submittal, provided that the project completes verification within 30 months of being submitted. If the project does not meet this deadline, it must be resubmitted under the latest version of the protocol; it will not retain the initial submittal date and will be subject to any new project start date requirements.

For pre-existing projects submitted by the April 30, 2010 deadline, possible actions denoting the start date, in addition to those described above, include:

- Implementation of a verifiable forest management plan that leads to the increased carbon stocks.
- Engaging in consulting services for the purposes of implementing a carbon project.

Forest Owners must affirm the action denoting the project start date by providing documentation. Adequate documentation could include deeds of trust, title reports, conservation easement documentation, dated forest management plans, and/or contracts or agreements.

3.3 Project Crediting Period

The baseline for any Forest Project registered with the Reserve under this version of the Forest Project Protocol is assumed to be valid for 100 years. This means that a registered Forest Project will be eligible to receive CRTs for GHG reductions and/or removals quantified using this

[3] See the Reserve's Program Manual for requirements for listing a project with the Reserve, available at http://www.climateactionreserve.org/how-it-works/program/program-manual/.

[4] Submitting a project to the Reserve is considered an initiation of a commitment to employ practices that will maintain or grow net carbon stocks for the duration of the FPP's commitment period, per the requirements of the FPP (Section 3.4) and signing the Project Implementation Agreement (PIA).

protocol and verified by Reserve-approved verification bodies, for a period of 100 years following the project's start date.

3.4 Minimum Time Commitment

Forest Owners must monitor and verify a Forest Project for a period of 100 years following the issuance of any CRT for GHG reductions or removals achieved by the project. For example, if CRTs are issued to a Forest Project in year 99 following its start date, monitoring and verification activities must be maintained until year 199. All Forest Projects must undergo an initial site-visit verification in order to register with the Reserve. After the initial verification all Forest Projects must undergo a site-visit verification at least once every six years. The only exception to this rule is for Reforestation Projects, which may defer a second site-visit verification beyond six years, at the Forest Owner's discretion. The third and subsequent site-visit verifications for Reforestation Projects must continue on a six-year cycle.

There are three possible exceptions to this minimum time commitment:

1. A Forest Project automatically terminates if a Significant Disturbance occurs,[5] leading to an Unavoidable Reversal that reduces the project's standing live tree carbon stocks below the project's baseline standing live tree carbon stocks. Once a Forest Project terminates in this manner, the Forest Owner has no further obligations to the Reserve.
2. A Forest Project may be voluntarily terminated prior to the end of its minimum time commitment if the Forest Owner retires a quantity of CRTs, as specified under 'Retiring CRTs Following Project Termination,' below.
3. A Forest Project may be automatically terminated if there is a breech of certain terms described within the Project Implementation Agreement. Such a termination will require the Forest Owner to retire a quantity of CRTs, as specified under 'Retiring CRTs Following Project Termination,' below.

Retiring CRTs Following Project Termination

a. For a Reforestation or Avoided Conversion Project, the Forest Owner must retire a quantity of CRTs from its Reserve account equal to the total number of CRTs issued to the project over the preceding 100 years.
b. For an Improved Forest Management Project, the Forest Owner must retire a quantity of CRTs from its Reserve account equal to the total number of CRTs issued to the project over the preceding 100 years, multiplied by the appropriate compensation rate indicated in Table 3.1.
c. In addition:
    i. The retired CRTs must be those that were issued to the Forest Project, or that were issued to other Forest Projects registered with the Reserve.
    ii. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.

[5] The natural disturbance shall not be the result of intentional or grossly negligent acts of the Forest Owner.

Table 3.1. Compensation Rate for Terminated Improved Forest Management Projects

Number of years that have elapsed between the start date and the date of termination	Compensation Rate
0-5	1.40
6-10	1.20
11-20	1.15
21-30	1.10
31-50	1.05
>50	1.00

3.5 Project Implementation Agreement

For a Forest Project to be eligible for registration with the Reserve, the Forest Owner is required to enter into a Project Implementation Agreement (PIA) with the Reserve. The PIA is an agreement between the Reserve and a Forest Owner setting forth: (i) the Forest Owner's obligation (and the obligation of its successors and assigns) to comply with the Forest Project Protocol, and (ii) the rights and remedies of the Reserve in the event of any failure of the Forest Owner to comply with its obligations. It is not possible to terminate the PIA for only a portion of the property. The PIA must be signed by the Forest Owner before a project can be registered with the Reserve. It must be signed by all entities that are fee simple owners of the Project Area property. The PIA is recorded and submitted after the Reserve has reviewed the verification documents and is about to register the project.

3.6 Use of Qualified Conservation Easements or Qualified Deed Restrictions

For Avoided Conversion Projects on private land, the Forest Owner must record a Qualified Conservation Easement against the project's property in order for the Forest Project to be eligible for registration with the Reserve. In addition, Qualified Conservation Easements or Qualified Deed Restrictions may be voluntarily employed with Reforestation Projects and Improved Forest Management Projects. Reforestation Projects and Improved Forest Management Projects that choose to employ Qualified Conservation Easements or Qualified Deed Restrictions have reduced obligations to the Reserve's CRT Buffer Pool, as described in Section 7 and Appendix D.

Qualified Conservation Easements and Qualified Deed Restrictions must be recorded no earlier than one year before a project's start date. If a Qualified Conservation Easement or Qualified Deed Restriction was recorded more than one year prior to the start date, the limits imposed by the easement or deed restriction on forest management activities must be considered as a legal mandate for the purpose of satisfying the legal requirement test for additionality (Section 3.1.1) and in determining the project's baseline (Section 6).

As indicated in Section 3.2, project start dates must be linked to a discrete, verifiable action. The recordation of a conservation easement may be used to denote the start date of pre-existing projects (i.e., those with start dates between January 1, 2001 and March 31, 2010). A subsequent date may only be used if a subsequent verifiable action can be identified denoting the start date. If a subsequent start date is identified, any previously recorded conservation

easement may only be considered a Qualified Conservation Easement if it was recorded within one year prior to the identified project start date.

3.7 Attestation of Title

Each time a Forest Project is verified, Forest Owners must sign the Reserve's standard Attestation of Title form indicating that they have an exclusive ownership claim to the GHG reductions and removals achieved by their Forest Project over the verification period. Copies of the Attestation of Title form are available on the Reserve's website. Please note that in requesting this form, the Reserve is not providing credit or acting as a broker to trade any Forest Project CRTs.

3.8 Project Location

All Forest Projects located in the United States of America are eligible to register with the Reserve, provided they meet all other eligibility requirements described in this protocol. Reforestation Projects and Improved Forest Management Projects may be located on private land or on state or municipal public land. Avoided Conversion Projects must be implemented on private land, unless the land is transferred to public ownership as part of the project.

All Forest Projects on public lands must be approved by the government agency or agencies responsible for management activities on the land. This approval must include an explicit approval of the project's baseline, as determined in Section 6, and must involve any public vetting processes necessary to evaluate management and policy decisions concerning the project activity.

Forest Projects on federal lands may be eligible if and when their eligibility is approved through a federal legislative or regulatory/rulemaking process. Forest Projects in tribal areas must demonstrate that the land within the Project Area is owned by a tribe or private entities.

Version 3.2 of the Forest Project Protocol contains data tables, equations, and benchmark data applicable to projects located in the United States. The Reserve may add approved equations and models as they are developed in future versions of the Forest Project Protocol.

The methods required by this protocol for estimating baseline carbon stocks for Forest Projects cannot currently be applied outside the United States, as they rely on U.S.-specific data sets and models.

3.9 Regulatory Compliance

Each time the Forest Project is verified, the Forest Owner must attest that the project is in material compliance with all applicable laws relevant to the project activity. Forest Owners are required to disclose in writing to the verifier any and all instances of material non-compliance of the project with any law. If a verifier finds that a project is in a state of recurrent non-compliance or non-compliance that is the result of negligence or intent, then CRTs will not be issued for GHG reductions that occurred during the period of non-compliance. Non-compliance solely due to administrative or reporting issues, or due to "acts of nature," will not affect CRT crediting.

3.10 Sustainable Harvesting and Natural Forest Management Practices

Forest Projects can create long-term climate benefits as well as provide other environmental benefits, including the sustaining of natural ecosystem processes. This protocol requires eligible

projects to employ both sustainable long-term harvesting practices and Natural Forest Management practices over time, as described below.

3.10.1 Sustainable Harvesting Practices

At the time commercial harvesting is either planned or initiated within the Project Area, the Forest Owner must employ and demonstrate sustainable long-term harvesting practices on all of its forest landholdings, including the Project Area, using one of the following options:

1. The Forest Owner must be certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System certification programs. Regardless of the program, the terms of certification must require adherence to and verification of harvest levels which can be permanently sustained over time.
2. The Forest Owner must adhere to a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency.
3. The Forest Owner must employ uneven-aged silvicultural practices (if harvesting occurs) and must maintain canopy cover averaging at least 40 percent across the entire forestland owned by the Forest Owner in the same Assessment Areas covered by the Project Area, as measured on any 20 acres within the Forest Owner's landholdings found in any of these Assessment Areas, including land within and outside of the Project Area (areas impacted by Significant Disturbance may be excluded from this test).

Forest Owners who acquire new forest landholdings within their entity have up to 5 years to incorporate such acquisitions under their certification or management plan, whether or not such land is contiguous with the Project Area.

3.10.2 Natural Forest Management

All Forest Projects must promote and maintain a diversity of native species and utilize management practices that promote and maintain native forests comprised of multiple ages and mixed native species within the Project Area and at multiple landscape scales ("Natural Forest Management").

All Forest Projects are required to establish and/or maintain forest types that are native to the Project Area. For the purposes of this protocol, native forests are defined as those forests occurring naturally in an area, as neither a direct nor indirect consequence of human activity post-dating European settlement.

Required references by Assessment Area for the definition of native forests are provided in an Assessment Area Data File maintained by the Reserve, which can be downloaded from the Forest Project Protocol Resources section of the Reserve's website. If a state/regional reference is unavailable or inadequate, the Forest Owner must provide documentation from a state botanist or other qualified independent resource, recognized as expert by academic, private and government organizations, indicating that the project employs native forests per the definition above. Where supported by scientific peer-reviewed research, the planting of native species outside of their current distribution is allowed as an adaptation strategy due to climate change. Such planting must be done in accordance with a state or federally approved adaptation plan, or a local plan that has gone through a transparent public review process. The Forest Owner must obtain a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the planting of native trees outside their current range is appropriate as an adaptation to climate change.

The following key requirements shall apply to all Forest Projects regardless of the silvicultural or regeneration methods that are used to manage or maintain the forest:

1. Forest Projects must maintain or increase standing live carbon stocks over the project life, as described in Section 3.9.3.
2. Forest Projects must show verified progress (verified at scheduled site-visit verifications) towards native tree species composition and distribution consistent with the forest type and forest soils native to the Assessment Area.
3. Forest Projects must manage the distribution of habitat/age classes and structural elements to support functional habitat for locally native plant and wildlife species naturally occurring in the Project Area, as specified in Table 3.2 and Section 3.9.4 below.

Forest Projects that initially engage in Natural Forest Management must continue to do so for as long as monitoring and verification of the Forest Project are required by this protocol. Forest Projects that do not initially meet Natural Forest Management criteria but can demonstrate progress towards meeting these criteria at the times identified in Table 3.2 are eligible to register with the Reserve.

The evaluation worksheet provided in Table 3.2 shall be used to determine if the Forest Project meets the criteria for engaging in Natural Forest Management. The following evaluation must be completed and verified at a Forest Project's first verification and at all subsequent verifications. Forest Project carbon stock inventories (requirements for which are contained in Appendix A) should be used as the basis of these assessments where applicable.

Table 3.2. Evaluation Criteria to Test if a Forest Project Meets the Requirement for the Establishment and Maintenance of Native Species and Natural Forest Management

Criteria	When Assessed	Results of not passing criteria	Application Rules
Native Species			
Project consists of at least 95% native species based on the sum of carbon in the standing live pool. The assessment shall be conducted using estimates of stems per acre for Reforestation Projects and basal area per acre for Improved Forest Management and Avoided Conversion Projects.	Assessed at initial verification from inventory data.	Forest Project is not eligible unless demonstrated that management will achieve this goal over the project life.	Applies to all project types throughout the project life.
	Assessment during site-visit verifications must demonstrate continuous progress toward goal. This criterion must be met within 50 years.	All of the Forest Project's Reserve account activity will be suspended until the criterion is met.	
Composition of Native Species			
Improved Forest Management and Avoided Conversion Projects Where the Project Area naturally consists of a mixed species distribution, no single species' prevalence, measured as the percent of the basal area of all live trees in the Project Area, exceeds the percentage value of standing live carbon shown under the heading 'Composition of Native Species' in the Assessment Area Data File maintained on the Reserve's website. Where the Project Area does not naturally consist of a mixed species distribution, the Forest Owner may request a variance from this criterion prior to Registration. **Reforestation** To the extent seed is available, and/or physical site	Species composition is assessed at initial verification from inventory data.	Project is not eligible, unless it is demonstrated that management activities will enable this goal to be achieved over the project life.	Applies to all project types throughout the project life. Some project sites may not be capable of meeting the requirement. In these cases, the Forest Owner may request a variance from the Reserve, following the Reserve's
	Species composition is also assessed during the project at each site-visit verification. Project must show continuous progress toward criteria. These criteria must be met within 50 years, except in cases where a variance has been granted at the initial verification, a Significant Disturbance has	Unless a variance has been granted, all of the project's Reserve account activity will be suspended until the criterion is met.	

characteristics permit, Reforestation Projects that involve planting of seedlings must plant a mixture of species such that no single species' prevalence, measured as the percent of all live tree stems in the Project Area, exceeds the percentage value shown under the heading 'Composition of Native Species' in the Assessment Area table in the Assessment Area Data File maintained on the Reserve's website. Where seed is unavailable, the Reforestation Project is based on natural regeneration, or physical site characteristics are limiting, the Forest Owner may request a variance from the Reserve excepting the Forest Project from this criterion prior to registration.	impacted species diversity, or natural mortality takes a project out of compliance.		standard variance application procedures.
Distribution of Age Classes/Sustainable Management			
All forest landholdings owned or controlled by the Forest Owner are currently under one of the following: 1. Third party certification under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System, whose certification standards require adherence to and verification of harvest levels which can be permanently sustained over time, or 2. Operating under a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency, or 3. The Forest Owner must employ uneven-aged silvicultural practices and canopy retention averaging at least 40 percent across the forest, as measured on any 20 acres within the entire forestland owned by the Forest Owner, including land within and outside of the Project Area. (Areas impacted by Significant Disturbance may be excluded from this test.)	Condition shall be met at all times during project and is assessed at each site-visit verification.	All Reserve account activity will be suspended until the criterion is met.	Applies to all project types at first regeneration harvest.
On a watershed scale up to 10,000 acres (or the project area, whichever is smaller), all projects must maintain, or make progress toward maintaining, no more than 40 percent of their forested acres in ages less than 20 years. (Areas impacted by Significant Disturbance may be excluded from this test.)	Age classes (if even-age management is used) are assessed at project initiation and each site-visit verification.	NA	
	Age classes are assessed during project at each site-visit verification. Project must show continuous progress toward criterion. This criterion must be met within 25 years.	All Reserve account activity will be suspended until the criterion is met..	
Structural Elements (Standing and Lying Dead Wood)			
Forest Owners must ensure that lying dead wood is retained in sufficient quantities, as described below. **For portions of the Project Area that have not recently undergone salvage harvesting:** If a verifier determines that the quantity of lying dead wood is commensurate with recruitment from standing dead trees (i.e. there is no evidence that lying dead wood has been actively removed), the Forest Owner must maintain (or demonstrate ongoing progress toward) an average of at least: ▪ one (1) metric ton of carbon (C) per acre; or	Assessed during project at each site-visit verification.	All Reserve account activity will be suspended, unless it is demonstrated that management will provide for these structural elements, or processes that produce these structural elements, over the project life.	Applies to all project types throughout the project life.

▪ 1% of standing live carbon stocks, in *standing* dead wood, whichever is higher. If a verifier determines that the quantity of lying dead wood is **not** commensurate with recruitment from standing dead trees (i.e. it appears lying dead wood has been actively removed), the Forest Owner must maintain (or demonstrate ongoing progress toward) an average of at least: ▪ two (2) metric tons of carbon (C) per acre; or ▪ 1% of standing live carbon stocks, in *standing* dead wood, whichever is higher, Standing dead wood may be evenly or unevenly distributed throughout the portion of the Project Area unaffected by salvage harvesting, as long as the appropriate minimum average tonnage per acre requirement is met. **For portions of the Project Area that have undergone salvage harvesting within the previous year:*** If a verifier determines that the quantity of lying dead wood following salvage harvest is commensurate with recruitment from standing dead trees, the Forest Owner must maintain (or demonstrate ongoing progress toward) an average of at least two (2) metric tons of carbon (C) per acre in *standing* dead wood, If a verifier determines that the quantity of lying dead wood following harvest is **not** commensurate with recruitment from standing dead trees, the Forest Owner must maintain (or demonstrate ongoing progress toward) an average of at least four (4) metric tons of carbon (C) per acre in *standing* dead wood, Standing dead wood may be evenly or unevenly distributed throughout the portion of the Project Area subject to salvage harvesting, as long as the appropriate minimum average tonnage per acre requirement is met. This requirement must be met for a period of 30 years following the salvage harvest. After 30 years, the portion of the Project Area subject to salvage harvesting must meet the requirements for portions that have not recently undergone salvage harvesting (described above).			

* Reforestation Projects submitted prior to September 1, 2010 are exempt from this requirement for salvage harvesting that occurred prior to the project's start date.

3.10.3 Promotion of the Onsite Standing Live Carbon Stocks

In an effort to promote and maintain the environmental benefits of Forest Projects, the Reserve requires that the standing live carbon stocks within the Project Area be maintained and/or increased during the project life. Therefore, except as specified below, the Reserve will not issue CRTs for quantified GHG reductions and removals achieved by a Forest Project if the Forest Project's monitoring reports – over any 10-year consecutive period – indicate a decrease in the standing live carbon stocks.

Exceptions to this policy are allowed where reductions in standing live carbon stocks are important for maintaining and enhancing forest health, environmental co-benefits, or the long-term security of all carbon stocks; where reductions are due to non-harvest disturbances; or where reductions are required by law. Note that these exceptions in no way change or affect the Reserve's policies and requirements related to compensating for reversals, as detailed in Section 7.3.

Forest Projects whose standing live carbon stocks have decreased over a 10-year period may continue to receive CRTs issued by the Reserve for verified GHG reductions and removals, if and only if the decrease in standing live carbon stocks is due to one of the following causes:

1. The decrease is demonstrably necessary to substantially improve the Project Area's resistance to wildfire, insect, or disease risks. The Forest Owner must document the risks and the actions that will be taken to reduce the risks. The techniques used to improve resistance must be supported by relevant published peer reviewed research.

2. The decrease is associated with a planned balancing of age classes (regeneration, sub-merchantable, and merchantable) and is detailed in a long term environmentally responsible management plan. The Forest Owner must demonstrate, using documentation submitted to the Reserve at the time of the Forest Project's registration, that the balancing of age classes, resulting in a decrease in the standing live carbon stocks, was planned at the initiation of the Forest Project (Figure 3.1).

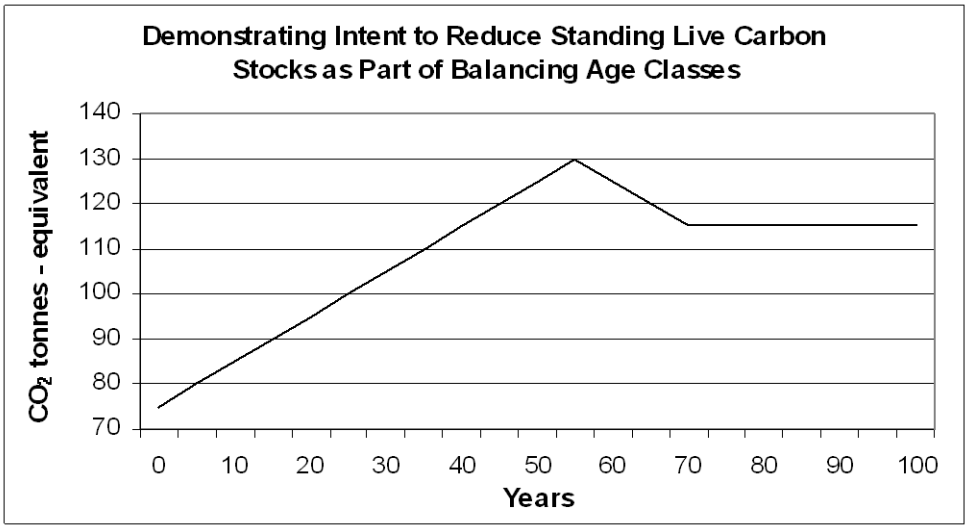


Figure 3.1. Example of Reducing Standing Live Carbon Stocks as Part of Balancing Age Classes

3. The decrease is part of normal silviculture cycles for forest ownerships less than 1,000 acres. Inventory fluctuations are a normal part of silvicultural activities. Periodic harvest may remove more biomass than the biomass growth over the past several years. At no time shall the Forest Project's inventory of carbon in the standing live carbon stocks fall below the Forest Project's baseline carbon stock estimates for the standing live carbon stocks, or 20 percent less than the Forest Project's standing live carbon stocks at the project's initiation, whichever is higher. Documentation submitted to the Reserve at the time the Forest Project is registered must indicate that fluctuations in the Forest Project's standing live carbon stocks are an anticipated silvicultural activity and that the overall trend will be for standing live carbon stocks to increase or stay the same over the life of

the project (Figure 3.2).

4. The decrease is part of a non-harvest disturbance, including wildfire, disease, flooding, wind-throw, insect infestation, landslides, or as otherwise approved by the Reserve.

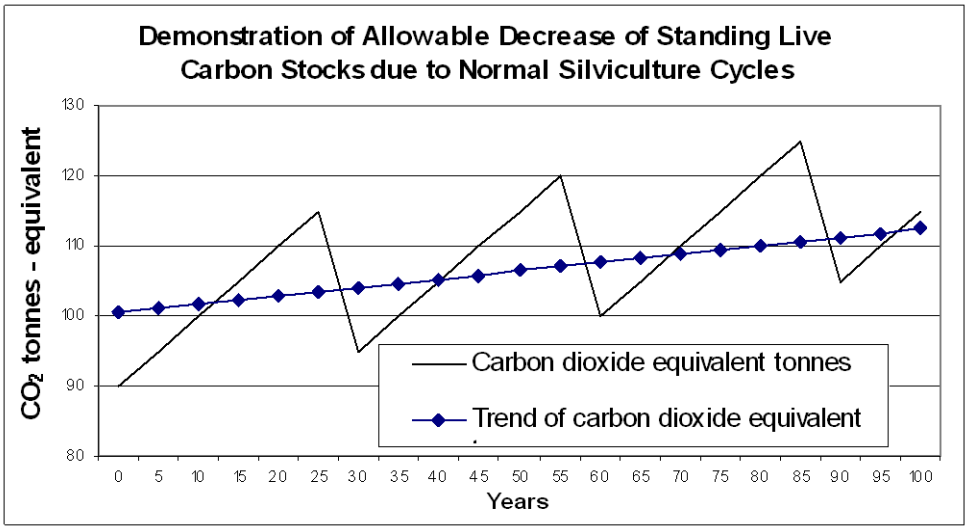


Figure 3.2. Example of Allowable Decrease of Standing Live Carbon Stocks due to Normal Silviculture Cycles

3.10.4 Balancing Age and Habitat Classes

A variety of silvicultural practices may be employed in the Project Area during the course of a Forest Project though the protocol does not endorse any particular practice. To ensure environmental integrity, Forest Projects must meet a minimum set of standards in the use of any such practices.

For projects that employ even-aged management practices, harvesting must be limited to stands no greater than 40 acres. Stands adjacent to recently harvested stands must not be harvested using an even-aged harvest until the average age of the adjacent stand is at least 5-years old, or the average height in the adjacent stand is at least 5 feet. On a watershed scale up to 10,000 acres, all projects must maintain, or make progress toward maintaining, no more than 40 percent of their forested acres in ages less than 20 years. Areas impacted by a Significant Disturbance are exempt from this test until 20 years after reforestation of such areas.

The protocol does not override a landowner's obligation to abide by applicable laws and regulations, including any governing forest practice rules that may be more stringent. Regardless of the silvicultural practice employed, landowners must fulfill their commitment under the protocol to permanently maintain or increase onsite standing live carbon stocks (i.e., the carbon in live trees within the Project Area) as specified in Section 3.9.3.

4 Identifying the Project Area

The geographic boundaries defining the Project Area must be described in detail at the time a Forest Project is listed on the Reserve. The boundaries must be defined using a map, or maps that displays public and private roads, major watercourses (4th order or greater), topography, towns, and public land survey townships, ranges, and sections or latitude and longitude. The maps should be of adequate resolution to clearly identify the requested features. The Project Area can be contiguous or separated into tracts. The Project Area may also extend across multiple Assessment Areas within a Supersection (see Appendix F).

For Improved Forest Management Projects, the geographic boundaries may be defined such that non-forested areas, or areas not under forest management, are excluded from the Project Area.

For Reforestation Projects, the Project Area must be on land that has had less than 10 percent tree canopy cover for a minimum of ten years, or that have been subject to a Significant Disturbance that resulted in at least 20% of the carbon stocks being emitted.

For Avoided Conversion Projects, the Project Area is defined through the required appraisal process. The Project Area must be determined following the guidance in Table 4.1 based on the type of anticipated conversion.

Table 4.1. Project Area Definition for Avoided Conversion Projects

Conversion Type	Project Area Definition
Residential	The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in residential development.
Agricultural Conversion	The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in agricultural production.
Golf Course	The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' as a golf course. This is to include forested areas within 200 feet of fairways, greens, and buildings.
Commercial Buildings	The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in commercial buildings.. This is to include forested areas with 200 feet of suitable building sites.

5 GHG Assessment Boundary

The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs that must be accounted for in quantifying a Forest Project's GHG reductions and removals (Section 6). The GHG Assessment Boundary encompasses all the GHG sources, sinks, and reservoirs that may be significantly affected by Forest Project activities, including forest carbon stocks, sources of biological CO_2 emissions, and mobile combustion GHG emissions. For accounting purposes, the sources, sinks, and reservoirs included in the GHG Assessment Boundary are organized according to whether they are predominantly associated with a Forest Project's "Primary Effect" (i.e. the Forest Project's intended changes in carbon stocks, GHG emissions, or GHG removals) or its "Secondary Effects" (i.e. unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the Forest Project).[6] Secondary Effects may include increases in mobile combustion CO_2 emissions associated with site preparation, as well as increased CO_2 emissions caused by the shifting of harvesting activities from the Project Area to other forestlands (often referred to as "leakage"). Projects are required to account for Secondary Effects following the methods described in Section 6.

The following tables provide a comprehensive list of the GHG sources, sinks, and reservoirs (SSRs) that may be affected by a Forest Project, and indicate which SSRs must be included in the GHG Assessment Boundary for each type of Forest Project. If a SSR is designated as a "reservoir/pool," this means that GHG reductions and removals are accounted for by quantifying changes in carbon stock levels. For SSRs designated as sources or sinks, GHG reductions and removals are accounted for by quantifying changes in GHG emission or removal rates, as described in the tables.

5.1 Reforestation Projects

Table 5.1. GHG Assessment Boundary – Reforestation Projects

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs						
RF-1	Standing live carbon (carbon in all portions of living trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by field measurements and updating forest carbon inventory	Increases in standing live carbon stocks are likely to be the largest Primary Effect of Reforestation Projects. For baseline estimation purposes, pre-existing trees must be distinguished from planted trees. Since pre-existing and new trees are easy to distinguish for several decades after tree planting, pre-existing trees do not need to be inventoried until the Forest Owner first seeks verification of GHG reductions and removals (subsequent to the project's initial site-visit verification and registration).
RF-2	Shrubs and herbaceous	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field	Shrubs and herbaceous understory may constitute a significant portion of carbon

[6] The terms "Primary Effect" and "Secondary Effect" come from WRI/WBCSD, 2005. *The Greenhouse Gas Protocol for Project Accounting*, World Resources Institute, Washington, DC. Available at http://www.ghgprotocol.org.

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
	understory carbon				inventory measurements **Project:** Measured by updating forest carbon inventory	affected by Reforestation Projects in initial years, e.g. during site preparation and over the course of the project.
RF-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Reforestation Projects will tend to significantly increase standing dead carbon stocks over time.
RF-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals. Accounting is focused on standing dead wood, since all lying dead wood originates as standing dead wood and standing dead wood lends itself to standard forest inventory sampling practices. The protocol encourages retention of lying dead wood as a structural element (see Section 3.9.2).
RF-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals.
RF-6	Soil carbon	Reservoir / Pool	CO_2	Optional or Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Soil carbon is not anticipated to change significantly as a result of most Reforestation Project activities. Soil carbon must be included in the GHG Assessment Boundary, however, if any of the following activities occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or ▪ Mechanical site preparation activities are not conducted on contours.
RF-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes	Included because many Reforestation Projects will significantly increase carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for CO_2 emissions from decomposition or disposal of wood products (see SSR #RF-17).
RF-8	Forest product	Reservoir	CO_2	Excluded	**Baseline:** Estimated	Because of significant uncertainties

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
	carbon in landfills	/ Pool		when project harvesting exceeds baseline Included when project harvesting is below baseline	from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes	associated with forecasting the quantity of forest product carbon that will remain stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated.
Secondary Effect Sources, Sinks, and Reservoirs						
RF-9	Biological emissions from site preparation activities	Source	CO_2	Included	**Baseline:** N/A **Project:** Quantified based on measured carbon stock changes in included reservoirs (SSRs #RF-2 and #RF-6)	Biological emissions from site preparation are not quantified separately but rather are captured by measuring changes in included carbon reservoirs (shrubs and herbaceous understory; soil carbon where applicable). Reforestation Projects are not eligible if harvesting of live trees (standing live carbon) has occurred within the Project Area within the last 10 years.
RF-10	Mobile combustion emissions from site preparation activities	Source	CO_2	Included	**Baseline:** N/A **Project:** Estimated using default emission factors	Mobile combustion CO_2 emissions from Reforestation Project site preparation activities can be significant relative to total GHG reductions/removals. In general, this protocol assumes that combustion emissions in the United States will be controlled under a regulatory cap-and-trade program in the near future, and can therefore be ignored in the context of Forest Project GHG accounting. Since these emissions are not currently capped, however, and because site preparation is a one-time event rather than an ongoing source of emissions, mobile combustion emissions are included in the GHG Assessment Boundary for this version of the Forest Project Protocol.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from mobile combustion associated with site preparation activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from mobile combustion associated with site preparation activities are not considered significant.
RF-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Mobile combustion CO_2 emissions from ongoing project operation & maintenance are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
						the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	CH_4 emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	N_2O emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.
RF-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Stationary combustion CO_2 emissions from ongoing project operation & maintenance could include GHG emissions associated with electricity consumption or heating/cooling at Forest Owner facilities, or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	CH_4 emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	N_2O emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
RF-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Included	**Baseline:** N/A **Project:** Estimated using default land-use conversion factors for non-project land	Reforestation Projects on land currently used for grazing or growing crops may cause displacement of these activities to other lands, leading to a reduction in carbon stocks on those lands (e.g. due to clearing of trees and shrubs). The shift may be either a market or physical response to the project activity. Emission associated with shifting land uses are estimated using default "leakage" factors from published sources.
RF-14	Biological emissions/ removals from changes in harvesting on forestland outside the Project Area	Source / Sink	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Reforestation Projects will tend to increase harvesting levels relative to the baseline, potentially causing other landowners to reduce harvesting in response to increased wood product supply. The reduction in harvesting may lead to increased carbon stocks on other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
						their permanence. Reforestation Projects are not expected to cause an increase in harvesting on other lands (except where clearing is involved for other land uses, per SSR #RF-13), so this potential effect is also excluded from the GHG Assessment Boundary.
RF-15	Combustion emissions from production, transportation, and disposal of forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest products. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
RF-16	Combustion emissions from production, transportation, and disposal of alternative materials to forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
RF-17	Biological emissions from decomposition of forest products	Source	CO_2	Included	**Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #RF-7) and landfills (SSR #RF-8) **Project:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #RF-7) and landfills (SSR #RF-8)	CO_2 emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR #RF-7 and Appendix C).
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	In-use wood products will produce little to no CH_4 emissions. CH_4 emissions can result from anaerobic decomposition of forest products in landfills. This protocol assumes that landfill CH_4 emissions will be largely controlled in the near future due to federal and/or state regulations. Thus, changes in forest-product production are assumed to have no significant effect on future CH_4 emissions from anaerobic decomposition of forest products in landfills. These emissions are therefore excluded from the GHG Assessment Boundary.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Decomposition of forest is not expected to be a significant source of N_2O emissions.

5.2 Improved Forest Management Projects

Table 5.2. GHG Assessment Boundary – Improved Forest Management Projects

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs						
IFM-1	Standing live carbon (carbon in all portions of living trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by field measurements and updating forest carbon inventory	Increases in standing live carbon stocks are likely to be the largest Primary Effect of Improved Forest Management Projects.
IFM-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals.

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
					Project: Measured by updating forest carbon inventory	
IFM-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Improved Forest Management Projects may significantly increase standing dead carbon stocks over time.
IFM-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals. Accounting is focused on standing dead wood, since all lying dead wood originates as standing dead wood and standing dead wood lends itself to standard forest inventory sampling practices. The protocol encourages retention of lying dead wood as a structural element (see Section 3.9.2).
IFM-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals.
IFM-6	Soil carbon	Reservoir / Pool	CO_2	Optional or Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory	Soil carbon is not anticipated to change significantly as a result of most Improved Forest Management Project activities. Soil carbon must be included in the GHG Assessment Boundary, however, if any of the following activities occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or ▪ Mechanical site preparation activities are not conducted on contours.
IFM-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes	Included because many Improved Forest Management Projects may significantly change carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for CO_2 emissions from decomposition or disposal of wood products (see SSR #IFM-17).
IFM-8	Forest product carbon in	Reservoir / Pool	CO_2	Excluded when project	**Baseline:** Estimated from modeled	Because of significant uncertainties associated with forecasting the quantity

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
	landfills			harvesting exceeds baseline Included when project harvesting is below baseline	harvesting volumes **Project:** Estimated from measured harvesting volumes	of forest product carbon that will remain stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated.
Secondary Effect Sources, Sinks, and Reservoirs						
IFM-9	Biological emissions from site preparation activities	Source	CO_2	Included	**Baseline:** N/A **Project:** Quantified based on measured carbon stock changes in included reservoirs (SSR #IFM-6, where applicable)	Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs (soil carbon, where applicable). For other carbon reservoirs, changes are unlikely to have a significant effect on total quantified GHG reductions/removals.
IFM-10	Mobile combustion emissions from site preparation activities	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Mobile combustion CO_2 emissions from site preparation are not expected to be significantly different from baseline levels for Improved Forest Management Projects. In addition, this protocol assumes that combustion emissions in the United States will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from mobile combustion associated with site preparation activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from mobile combustion associated with site preparation activities are not considered significant.
IFM-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Mobile combustion CO_2 emissions from ongoing project operation & maintenance are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.
IFM-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Stationary combustion CO_2 emissions from ongoing project operation & maintenance could include GHG emissions associated with electricity consumption or heating/cooling at Forest Owner facilities, or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
IFM-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Improved Forest Management Projects are not expected to cause significant shifts in alternative land uses that might lead to clearing of forestland.
IFM-14	Biological emissions/ removals from changes in harvesting on forestland outside the Project Area	Source / Sink	CO_2	Included / Excluded	**Baseline:** N/A **Project:** Estimated using a default 20% "leakage" factor applied to the difference in harvest volume relative to baseline	Improved Forest Management Projects may either increase or decrease harvesting relative to baseline levels. If harvesting is reduced in the Project Area, harvesting on other lands may increase to compensate for the lost production. This "leakage" effect is included in the GHG Assessment Boundary. If harvesting is increased in the Project Area, harvesting on other lands may decrease in response to the increased production. The reduction in harvesting may lead to increased carbon stocks on other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure their permanence.
IFM-15	Combustion emissions from production, transportation,	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
	and disposal of forest products					Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest products. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
IFM-16	Combustion emissions from production, transportation, and disposal of alternative materials to forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
IFM-17	Biological emissions from decomposition of forest products	Source	CO_2	Included	**Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8) **Project:** Quantified as a component of calculating carbon	CO_2 emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR #IFM-7 and Appendix C).

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
					stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8)	
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	In-use wood products will produce little to no CH_4 emissions. CH_4 emissions can result from anaerobic decomposition of forest products in landfills. This protocol assumes that landfill CH_4 emissions will be largely controlled in the near future due to federal and/or state regulations. Thus, changes in forest-product production are assumed to have no significant effect on future CH_4 emissions from anaerobic decomposition of forest products in landfills. These emissions are therefore excluded from the GHG Assessment Boundary.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Decomposition of forest is not expected to be a significant source of N_2O emissions.

5.3 Avoided Conversion Projects

Table 5.3. GHG Assessment Boundary – Avoided Conversion Projects

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs						
AC-1	Standing live carbon (carbon in all portions of living trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by field measurements and updating forest carbon inventory	Preservation of standing live carbon stocks relative to baseline levels is likely to be the largest Primary Effect of Avoided Conversion Projects.
AC-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals.
AC-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates	Avoided Conversion Projects may significantly increase standing dead carbon stocks over time.

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
					Project: Measured by updating forest carbon inventory	
AC-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals. Accounting is focused on standing dead wood, since all lying dead wood originates as standing dead wood and standing dead wood lends itself to standard forest inventory sampling practices. The protocol encourages retention of lying dead wood as a structural element (see Section 3.9.2).
AC-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Optional	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory	Inclusion is optional since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals.
AC-6	Soil carbon	Reservoir / Pool	CO_2	Optional or Included	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory	Soil carbon is not anticipated to change significantly as a result of most Avoided Conversion Project activities. Soil carbon must be included in the GHG Assessment Boundary, however, if any of the following activities occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or ▪ Mechanical site preparation activities are not conducted on contours.
AC-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes	Included because many Avoided Conversion Projects may significantly change carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for CO_2 emissions from decomposition or disposal of wood products (see SSR #AC-17).
AC-8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded when project harvesting exceeds baseline Included when project harvesting is	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes	Because of significant uncertainties associated with forecasting the quantity of forest product carbon that will remain stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
				below baseline		levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated.
Secondary Effect Sources, Sinks, and Reservoirs						
AC-9	Biological emissions from site preparation activities	Source	CO_2	Included	**Baseline:** N/A **Project:** Quantified based on measured carbon stock changes in included reservoirs (SSR #AC-6, where applicable)	Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs (soil carbon, where applicable). For other carbon reservoirs, changes are unlikely to have a significant effect on total quantified GHG reductions/removals.
AC-10	Mobile combustion emissions from site preparation activities	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Mobile combustion CO_2 emissions from site preparation (including land-use conversion activities) are likely to be higher in the baseline than under project. These emissions are therefore excluded from the GHG Assessment Boundary in order to be conservative. In addition, this protocol assumes that combustion emissions in the United States will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Differences in CH_4 emissions from mobile combustion associated with site preparation activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Differences in N_2O emissions from mobile combustion associated with site preparation activities are not considered significant.
AC-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Mobile combustion CO_2 emissions from ongoing project operation & maintenance are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from mobile combustion associated with ongoing project operation & maintenance activities are not considered significant.

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
AC-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Stationary combustion CO_2 emissions from ongoing project operation & maintenance could include GHG emissions associated with electricity consumption or heating/cooling at Forest Owner facilities, or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from (or will be lower than) baseline levels and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Changes in CH_4 emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Changes in N_2O emissions from stationary combustion associated with ongoing project operation & maintenance activities are not considered significant.
AC-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Included	**Baseline:** N/A **Project:** Estimated using default forestland conversion factors	Avoided Conversion Projects may cause land-use pressures to shift to other forestlands, causing biological emissions that partially negate the benefits of the project.
AC-14	Biological emissions/ removals from changes in harvesting on forestland outside the Project Area	Source / Sink	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Over time, Avoided Conversion Projects will tend to increase harvesting levels relative to the baseline, potentially causing other landowners to reduce harvesting in response to increased wood product supply. The reduction in harvesting may lead to increased carbon stocks on other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure their permanence. Avoided Conversion Projects are not expected to cause an increase in harvesting on other lands over the long run (except where clearing is involved for other land uses, per SSR #AC-13), so this potential effect is also excluded from the GHG Assessment Boundary.
AC-15	Combustion emissions from production, transportation, and disposal of forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
						products. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of forest products are not considered significant.
AC-16	Combustion emissions from production, transportation, and disposal of alternative materials to forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A	Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related CH_4 emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Combustion-related N_2O emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
AC-17	Biological emissions from decomposition of forest products	Source	CO_2	Included	**Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #AC-7) and landfills (SSR #AC-8) **Project:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #AC-7) and landfills (SSR #AC-	CO_2 emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR #AC-7 and Appendix C).

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
					8)	
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	In-use wood products will produce little to no CH_4 emissions. CH_4 emissions can result from anaerobic decomposition of forest products in landfills. This protocol assumes that landfill CH_4 emissions will be largely controlled in the near future due to federal and/or state regulations. Thus, changes in forest-product production are assumed to have no significant effect on future CH_4 emissions from anaerobic decomposition of forest products in landfills. These emissions are therefore excluded from the GHG Assessment Boundary.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Decomposition of forest is not expected to be a significant source of N_2O emissions.

6 Quantifying Net GHG Reductions and Removals

This section provides requirements and guidance for quantifying a Forest Project's net GHG reductions and removals. The Reserve will issue Climate Reserve Tonnes (CRTs) to a Forest Project upon confirmation by an ISO-accredited and Reserve-approved verification body that the Forest Project's GHG reductions and removals have been quantified following the applicable requirements of this section (see Section 10 for verification requirements).

For each type of Forest Project, quantification proceeds in seven steps:

1. **Estimating baseline onsite carbon stocks.** The baseline is an estimate of what would have occurred in the absence of a Forest Project. To establish baseline onsite carbon stocks, the Forest Owner must model 100 years of carbon stock changes in each of the Forest Project's required and selected optional onsite carbon pools (identified in Sections 5.1 to 5.3). Modeling must be based on inventoried carbon stocks at the time of the Forest Project's initiation (or when first inventoried as is allowed for Reforestation Projects), following the applicable requirements in this section. Onsite carbon stocks are inventoried following the requirements in Appendix A; modeling of onsite carbon stocks over time must be conducted following the requirements in this section and the guidance in Appendix B. Baseline onsite carbon stocks are estimated over a Forest Project's entire crediting period (100 years) at the time of the project's initiation and are not modified thereafter.
2. **Estimating baseline carbon in harvested wood products.** In conjunction with modeling baseline onsite carbon stocks, the Forest Owner must forecast any harvesting that would have occurred in the baseline and convert this to an average annual harvesting volume. From this, the Forest Owner must determine the amount of carbon that would have been transferred each year (on average) to long-term storage in wood products. Baseline harvesting is forecasted following the guidance in this section and carbon stored in wood products must be calculated following the requirements in Appendix C.
3. **Determining actual onsite carbon stocks.** Each year, the Forest Owner must determine the Forest Projects' actual onsite carbon stocks. This must be done by updating the Forest Project's forest carbon inventory for the current year, following the guidance in this section and in Appendices A and B. The estimate of actual onsite carbon stocks must be adjusted by an appropriate confidence deduction, as described in Appendix A, Section A.4.
4. **Determining actual carbon in harvested wood products.** Each year, the Forest Owner must report any harvesting in the Project Area and from this determine the amount of carbon transferred to long-term storage in wood products. Carbon stored in wood products must be calculated following the requirements in Appendix C.
5. **Calculating the project's Primary Effect.** Each year, the Forest Owner must quantify the actual change in GHG emissions or removals associated with the Forest Project's intended ("Primary") effect, as defined in Section 5. For any given year, the Primary Effect is calculated by:
    a. Taking the difference between actual onsite carbon stocks for the current year and actual onsite carbon stocks for the prior year[7]

[7] For the purposes of calculating the project's Primary Effect, actual and baseline carbon stocks prior to the start date of the project are assumed to be zero.

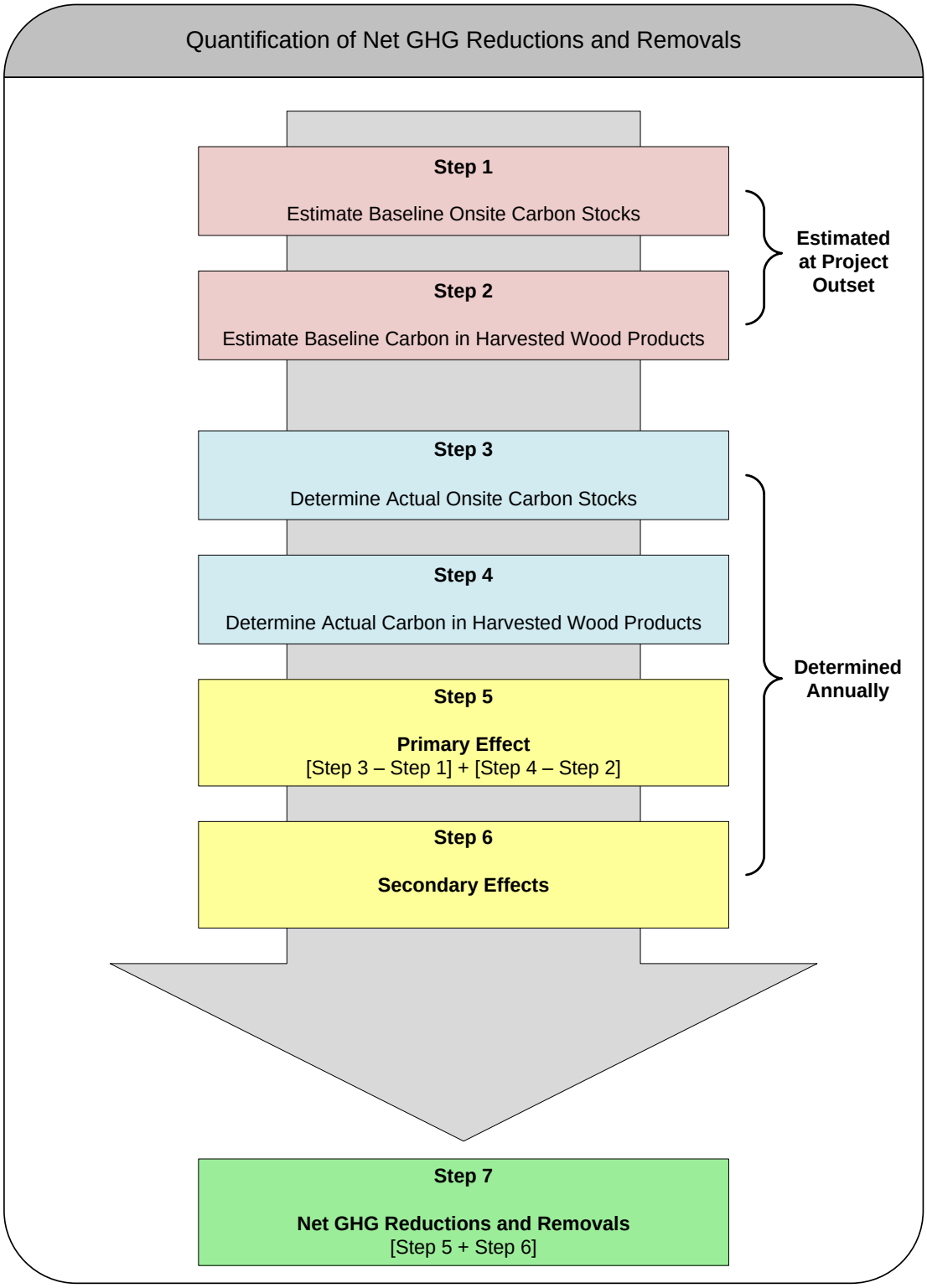
   b. Subtracting from (a) the difference between baseline onsite carbon stocks for the current year and baseline onsite carbon stocks for the prior year[8]
   c. Adding to (b) the calculated difference between actual and baseline carbon in harvested wood products for the current year (see Equation 6.1)
6. **Quantifying the project's Secondary Effects.** Each year, the Forest Owner must quantify the actual change in GHG emissions or removals associated with the Forest Project's unintended ("Secondary") effects, as defined in Section 5. Requirements and guidance for quantifying Secondary Effects are provided below for each type of Forest Project. Secondary Effects will almost always be negative (i.e. they will reflect an increase in GHG emissions caused by the project).
7. **Calculating total net GHG reductions and removals.** For each year, total net GHG reductions and removals are calculated by summing a Forest Project's Primary and Secondary Effects. If the result is positive, then the Forest Project has generated GHG reductions and/or removals in the current year. If the result is negative, this may indicate a reversal has occurred (see Section 7).[9]

Requirements and guidance for how to perform quantification steps 1-4 for each Forest Project type are presented in the remainder of this section. An example of annual GHG reduction/removal calculations for a hypothetical Forest Project is shown in Table 6.4 at the end of this section (page 60).

The required formula for quantifying annual net GHG reductions and removals is presented in Equation 6.1. Net GHG reductions and removals must be quantified and reported in units of carbon dioxide-equivalent (CO_2e) metric tons.

[8] See footnote 7.

[9] A reversal occurs only if: (1) total net GHG reductions and removals for the year are negative; and (2) CRTs have previously been issued to the Forest Project. If calculated GHG reductions and removals are negative and no CRTs have been issued to the project since its start date, then the result should be treated as a "negative carryover" to GHG reduction calculations in subsequent years (variable N_{y-1} in Equation 6.1). This may happen, for example, because the confidence deduction applied to actual onsite carbon stocks can result in actual values being less than baseline values in a Forest Project's initial years.


Quantification of Net GHG Reductions and Removals
Step 1
Estimate Baseline Onsite Carbon Stocks
Step 2
Estimate Baseline Carbon in Harvested Wood Products
Estimated at Project Outset
Step 3
Determine Actual Onsite Carbon Stocks
Step 4
Determine Actual Carbon in Harvested Wood Products
Step 5
Primary Effect
[Step 3 – Step 1] + [Step 4 – Step 2]
Step 6
Secondary Effects
Determined Annually
Step 7
Net GHG Reductions and Removals
[Step 5 + Step 6]

Equation 6.1. Annual Net GHG Reductions and Removals

$$\mathbf{QR_y = [(\Delta\ AC_{onsite} - \Delta\ BC_{onsite}) + (AC_{wp,\,y} - BC_{wp,\,y}) \times 80\% + SE_y] \times (1 - ACD) + N_{y-1}}$$

Where,

QR_y = Quantified GHG reductions and removals for year y

$\Delta\ AC_{onsite}$ = $(AC_{onsite,\,y})(1 - CD_y) - (AC_{onsite,\,y-1})(1 - CD_{y-1})$

Where,

$AC_{onsite,\,y}$ = Actual onsite carbon (CO_2e) as inventoried for year y

$AC_{onsite,\,y-1}$ = Actual onsite carbon (CO_2e) as inventoried for year y-1 (if y is the first year of the project, then the value for $AC_{onsite,\,y-1}$ will be zero)

CD_y = Appropriate confidence deduction for year y, as determined in Appendix A, Section A.4

CD_{y-1} = Appropriate confidence deduction for year y-1, as determined in Appendix A, Section A.4

$\Delta\ BC_{onsite}$ = $BC_{onsite,\,y} - BC_{onsite,\,y-1}$

Where,

$BC_{onsite,\,y}$ = Baseline onsite carbon (CO_2e) as estimated for year y

$BC_{onsite,\,y-1}$ = Baseline onsite carbon (CO_2e) as estimated for year y-1 (if y is the first year of the project, then the value for $BC_{onsite,\,y-1}$ will be zero) [10]

$AC_{wp,\,y}$ = Actual carbon in wood products produced in year y that is projected to remain stored for at least 100 years (i.e. $WP_{total,\,y}$ derived for actual harvest volumes following the guidance in Appendix C)

$BC_{wp,y}$ = Averaged annual baseline carbon in wood products that would have remained stored for at least 100 years (i.e. $WP_{total,\,y}$ derived for baseline harvest volumes following the guidance in Appendix C)

SE_y = Secondary Effect GHG emissions caused by the project activity in year y

ACD = Avoided Conversion Project discount factor, determined in Section 6.3.1

N_{y-1} = Any negative carryover from the prior year (occurs when total quantified GHG reductions are negative prior to the issuance of any CRTs for the project– see footnote 9, p. 38)

Note: The net change in carbon in harvested wood products, ($AC_{wp,\,y} - BC_{wp,\,y}$), is multiplied by 80 percent in Equation 6.1 to reflect market responses to changes in wood-product production. The general assumption in this protocol is that for every tonne of reduced harvesting caused by

[10] For Improved Forest Management Projects, where baseline onsite carbon stocks are averaged across all years, the value for $\Delta\ BC_{onsite}$ will be zero in all years except the first year of the project.

a Forest Project, the market will compensate with an increase in harvesting of 0.2 tonnes on other lands (see Section 6.2.6).[11] Since wood product production is directly related to harvesting levels, the net change in wood products caused by a Forest Project is subject to this same market dynamic. Thus, any one tonne increase/decrease in wood product production by a Forest Project will result in only a 0.8 tonne increase/decrease overall, because other landowners will decrease/increase production by 0.2 tonnes in response.

6.1 Reforestation Projects

6.1.1 Estimating Baseline Onsite Carbon Stocks

To estimate baseline carbon stocks for a Reforestation Project, the Forest Owner must:

1. Provide a qualitative characterization of the likely vegetative conditions and activities that would have occurred without the project, taking into consideration any laws, statutes, regulations, or other legal mandates that would encourage or require reforestation on the Project Area. The qualitative assessment shall include an assessment of the commercial value of trees within the project area over the next 30 years. The qualitative assessment must be used as the basis for modeling baseline carbon stocks (Step 3).

2. Inventory the carbon stocks in each of the project's required and selected optional carbon pools, following the requirements and guidance in Appendix A of this protocol.[12] For carbon pools that will be affected by site preparation, the inventory must be conducted prior to any site preparation activities. For those carbon pools that are affected by site preparation, Forest Owners must provide an estimate of initial carbon stocks using one of the following alternatives:
    - Measuring carbon stocks using 20 sample plots located in the portion of the Project Area containing the greatest amount of biomass in the pool that will be affected.
    - Stratifying (classifying) the Project Area into similar densities and measuring stocks within the affected carbon pools using 20 sample plots per density class.
    - Measuring the affected carbon stocks based on a grid system across the Project Area.

For other carbon stocks, the inventory may be deferred, as described below.

3. Once a full inventory is obtained, perform a computer simulation that models the carbon stocks (from required and any selected optional pools) for 100 years following the project's start date, based on the qualitative characterization of what would have occurred without the project. The Forest Owner must follow the requirements and guidance for modeling contained in Appendix B, Section B.3, incorporating any conditions and constraints specified in the qualitative characterization of the baseline (Step 1, above). The computer simulation must model the expected growth in carbon stocks associated with pre-existing trees in the Project Area (i.e. those not planted as part of the Forest Project).

[11] For conservativeness and ease of accounting, these wood-product market "leakage" effects are ignored for Reforestation Projects and Avoided Conversion Projects, since overall these projects will tend to result in increased harvesting relative to the baseline. Market leakage effects are accounted for under Improved Forest Management Projects, however, as described in Section 6.2.6.

[12] Initial carbon stocks could be zero if the Project Area has no quantifiable forest cover or required carbon pools.

Deferral of Initial Inventory for Carbon Stocks Not Affected by Site Preparation

The inventory of carbon stocks that are not affected by site preparation may be deferred until a Reforestation Project's second site-visit verification. At the time of the second site-visit verification, the Forest Owner must provide an estimated inventory of the all required and chosen optional carbon stocks at the time of the Forest Project's start date by:

1. Assuming standing dead carbon stocks at the time of the Forest Projects' start date were equal to the standing dead carbon stocks measured and verified at the second site-visit verification.
2. Using an approved growth model or a stand table projection methodology, as described in Appendix B, Section B.1, to derive an estimate of standing live carbon stocks in pre-existing trees (i.e. those not planted as part of the Forest Project) at the time of the Forest Project's start date. The Forest Owner must demonstrate that applying the approved growth model or stand table projection to the estimate produces a result within 5 percent of current inventory data for pre-existing trees.

If the inventory of these carbon pools is deferred, the timing of the second site-visit verification is at the discretion of the Forest Owner (it may be deferred for more than six years). Reforestation Projects for which an initial inventory is deferred are not eligible to receive CRTs until after the second site-visit verification.

6.1.2 Estimating Baseline Carbon in Harvested Wood Products

If harvesting of the pre-existing trees would be expected to occur in the baseline, the following steps must be performed:

1. Use a model (see guidance in Appendix B) to determine the *average* amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year of the baseline over 100 years. The result will be a uniform estimate of harvested carbon in each year of the baseline. This estimate is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.
2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.1.3 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Reforestation Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in Appendix B. Guidance for projecting forest inventory plot data using models is also provided in Appendix B.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in Appendix A, Section A.4.

6.1.4 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.1.3).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.1.5 Quantifying Secondary Effects

For Reforestation Projects, significant Secondary Effects can arise from two sources:

1. One-time combustion emissions associated with machinery use in site preparation; and
2. The shifting of cropland or grazing activities to forestland outside the Project Area (which may be both a market and/or physical response to the project activity), which is accounted for over the life of the project.

To quantify combustion emissions associated with site preparation, Forest Owners must use the appropriate standard emission factor from Table 6.1 corresponding to the level of brush cover on the Project Area, multiplied by the number of acres in the Project Area (Equation 6.2).

Mobile combustion emissions must be added to Secondary Effect emissions (SE_y in Equation 6.1) in the first year of a project. If this results in a negative amount for total net quantified GHG reductions and removals in year one (QR_1), the negative amount must be carried over into future years (N_{y-1} in Equation 6.1) until sufficient GHG reductions and removals are accrued to achieve a positive balance. Negative GHG reductions and removals due to site preparation emissions are *not* considered a reversal (Section 7.1).

Equation 6.2. Combustion Emissions Associated with Site Preparation

$$\mathbf{MC_y = (-1) \times (EF_{mc} \times PA)}$$

Where,

MC_y = Secondary Effect CO_2e emissions due to mobile combustion from site preparation
EF_{mc} = Mobile combustion emission factor from Table 6.1
PA = The size of the Project Area, in acres

Table 6.1. Mobile Combustion Emissions for Reforestation Projects

Site Prep - Reforestation Projects		
Emissions Associated with Mobile Combustion Average Metric Tons CO_2 per Acre		
Light	**Medium**	**Heavy**
25% Brush Cover	50% Dense Brush Cover	> 50% Brush Cover, stump removal
0.090	**0.202**	**0.429**

To quantify emissions from the shifting of cropland and grazing activities each year, Forest Owners must determine the appropriate "leakage" risk percentage for the project following the decision tree in Figure 6.3. The leakage risk percentage must only be determined once, at the outset of the project. Each year, this percentage must be applied to the net increase in onsite carbon stocks to determine the annual Secondary Effects due to shifting of cropland or grazing activities (Equation 6.3).

Equation 6.3. Emissions from Shifting Cropland and Grazing Activities

$$AS_y = (-1) \times L \times (\Delta AC_{onsite} - \Delta BC_{onsite})$$

Where,

AS_y	=	Secondary Effect CO_2e emissions due to shifting of cropland or grazing activities
L	=	Leakage risk percentage, as determined from Figure 6.3
ΔAC_{onsite}	=	Annual difference in actual onsite carbon (CO_2e) as defined in Equation 6.1
ΔBC_{onsite}	=	Annual difference in baseline onsite carbon (CO_2e) as defined in Equation 6.1

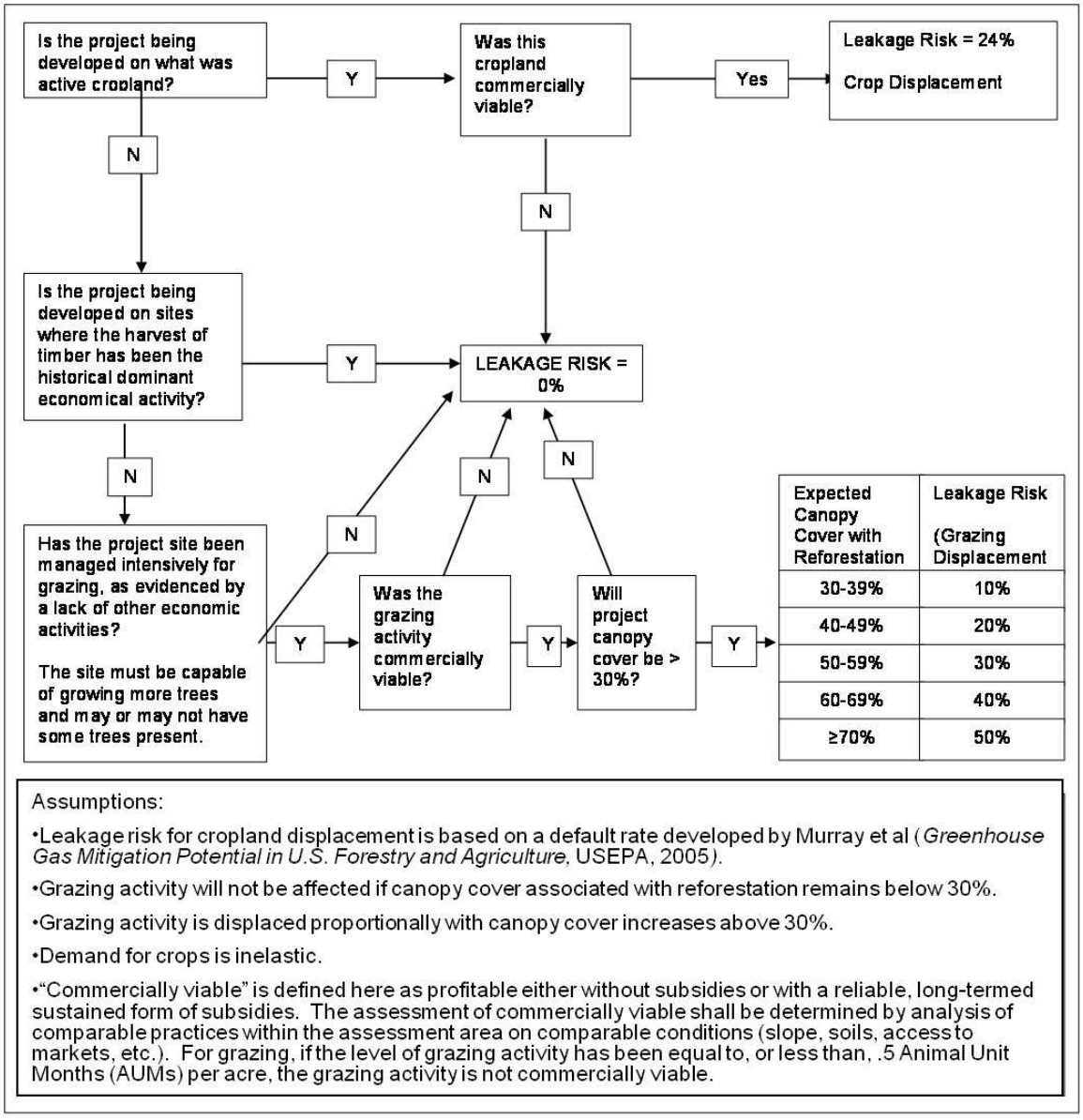


Figure 6.3. Activity Shifting ("Leakage") Risk Assessment for Reforestation Projects

Total Secondary Effect emissions for Reforestation Projects are calculated as follows (Equation 6.4). The value for Secondary Effect emissions will always be negative or zero.

Equation 6.4. Total Secondary Effect Emissions

$\mathbf{SE_y = (AS_y + MC_y)}$ *or* **0**, whichever is lower

Where,

SE_y = Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1)
AS_y = Secondary Effect CO_2e emissions due to shifting of cropland or grazing activities
MC_y = Secondary Effect CO_2e emissions due to mobile combustion from site preparation*
*only occurs in year 1

6.2 Improved Forest Management Projects

Improved Forest Management Projects that take place on private land – or on land that is transferred to public ownership at the time the project is initiated – must estimate baseline onsite carbon stocks following the requirements and procedures in Section 6.2.1. Improved Forest Management Projects that take place on land that was publicly owned prior to the project start date must estimate baseline onsite carbon stocks following the requirements and procedures in Section 6.2.2. Requirements for determining baseline carbon in harvested wood products, determining actual onsite carbon stocks, determining actual carbon in harvested wood products, and quantifying Secondary Effects are the same for all Improved Forest Management Projects.

6.2.1 Estimating Baseline Onsite Carbon Stocks – Private Lands

The baseline approach for Improved Forest Management Projects on private lands applies a standardized set of assumptions to project-specific conditions. A key assumption is that baseline carbon stocks will depend on how a project's initial standing live carbon stocks compare to "Common Practice," defined as the average standing live carbon stocks on similar lands within the project's Assessment Area. In addition, baseline carbon stocks may be adjusted to reflect management practice on a Forest Owner's other landholdings in instances where Project Area carbon stocks differ markedly (i.e., by more than 20 percent) from carbon stocks on land within the same logical management unit. Finally, the baseline must be modeled to reflect all legal and economic constraints affecting the Project Area.

The following steps must be followed to estimate baseline carbon stocks:

1. Determine the Common Practice level of above-ground standing live carbon stocks applicable to the Project Area.
2. Determine if the Project Area's initial *above-ground* standing live carbon stocks are above or below Common Practice.
3. Estimate baseline above-ground standing live carbon stocks, taking into account financial and legal constraints on harvesting in the Project Area, as well as the minimum baseline level applicable to the Project Area, as defined in the guidance for Step 3, below. The minimum baseline level will depend on whether initial above-ground standing live carbon stocks are above or below Common Practice.
4. Determine the baseline carbon stocks over 100 years for all required and optional carbon pools in the Project Area.

For all calculations in this section, all values for "carbon stocks" should be expressed in metric tonnes of CO_2-equivalent.

Step 1 – Determine the Common Practice Carbon Stocks for the Project's Assessment Area

As defined in this protocol, Common Practice refers to the average stocks of *above-ground* standing live carbon associated with the Assessment Area(s) covered by the Project Area. Common Practice is used as a reference point for baseline estimation. To determine a value for Common Practice, consult the guidance in Appendix F.

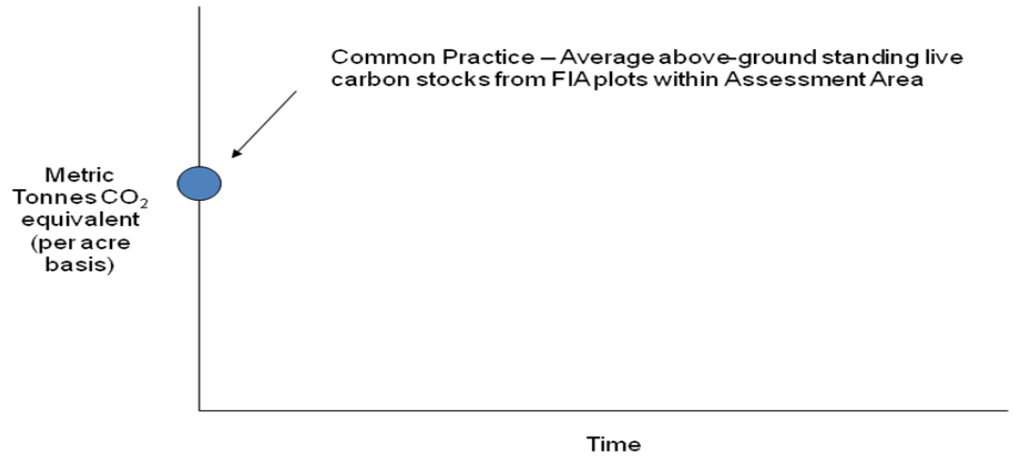


Figure 6.4. Common Practice as a Reference Point for Baseline Estimation

Step 2 – Determine if Initial Above-Ground Standing Live Carbon Stocks Are Above or Below Common Practice

To determine if initial above-ground standing live carbon stocks are above or below Common Practice, perform the following steps:

1. From the initial forest carbon inventory for the Project Area (conducted following the requirements and guidance in Appendix A), identify the metric tons of carbon contained in the *above-ground portion* of standing live carbon stocks.
2. Divide this amount by the number of acres in the Project Area.
3. Compare the result with the Common Practice value identified in Step 1.

Step 3 – Determine Baseline Above-Ground Standing Live Carbon Stocks

The baseline above-ground standing live carbon stocks must be determined by: (1) Modeling above-ground standing live carbon stocks through a series of growth and harvesting scenarios over 100 years; and (2) averaging the model results over the 100-year timeframe, so that the baseline is expressed as a single (average) value for above-ground standing live carbon stocks per acre in every year. The modeling must be performed following the guidance in Appendix B and must meet the following conditions:

1. Growth and harvesting scenarios must reflect all legal constraints, following the requirements in Section 6.2.1.2 (below).
2. Growth and harvesting scenarios must reflect any financial constraints, following the requirements in Section 6.2.1.3 (below).
3. The averaged model results, expressed as above-ground standing live carbon stocks per acre, must not fall below a minimum baseline level (MBL). If initial above-ground standing live carbon stocks are above Common Practice, the MBL must be determined using the formula in Equation 6.5. If initial above-ground standing live carbon stocks are below Common Practice, then MBL must be determined using the formula in Equation 6.6.

A graphical example of a baseline meeting these conditions is provided in Figures 6.5 and 6.6. Figure 6.5 shows the baseline before averaging; Figure 6.6 shows the baseline after averaging.

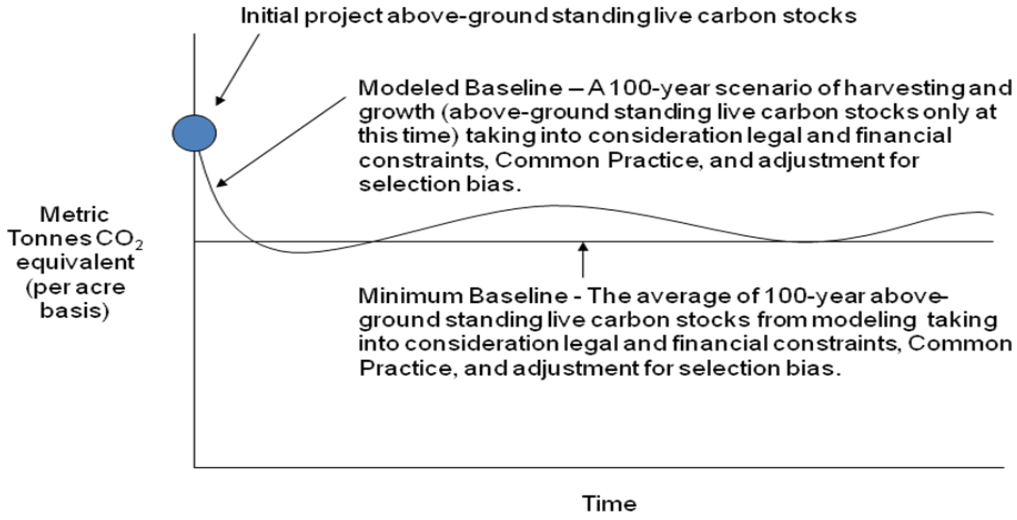


Figure 6.5. Modeling Standing Live Carbon Stocks Where Initial Stocks Are Above Common Practice

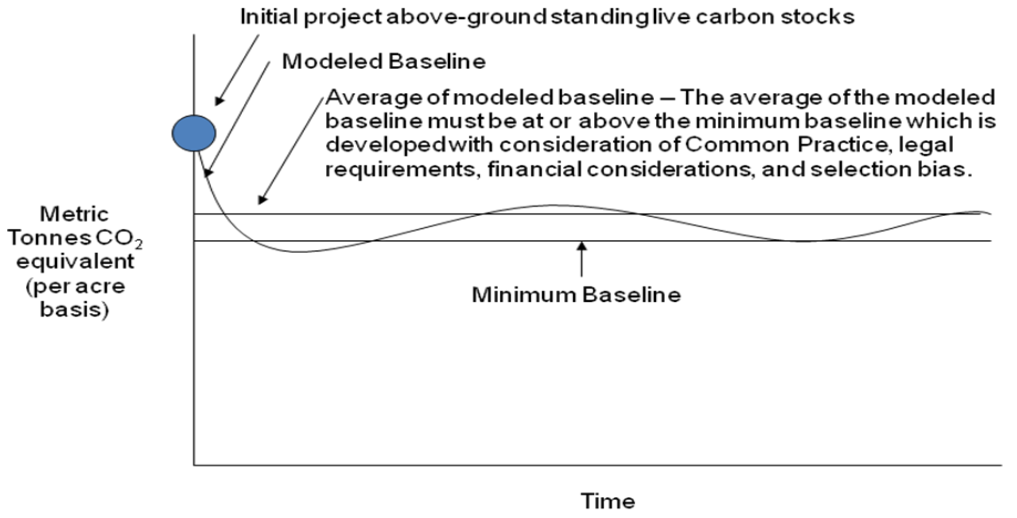


Figure 6.6. Averaging the Modeled Standing Live Carbon Stocks Where Initial Stocks Are Above Common Practice

Equation 6.5. Determining the Minimum Baseline Level Where Initial Stocks Are Above Common Practice

MBL = MAX (CP, MIN (ICS, CP + ICS – WCS))

Where,

MBL = Minimum baseline level (above-ground standing live carbon stocks)

CP = Common Practice (as determined in Step 1)

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 2)

WCS = The weighted average above-ground standing live carbon stocks per acre for all Forest Owner (and affiliate) landholdings within the same logical management unit as the Project Area. See Section 6.2.1.1 for requirements and guidance on calculating WCS

Equation 6.6. Determining the Minimum Baseline Level Where Initial Stocks Are Below Common Practice

MBL = MAX (MAX (HSR, ICS), MIN (CP, WCS))

Where,

MBL = Minimum baseline level (above-ground standing live carbon stocks)

HSR = The "High Stocking Reference" for the Project Area. The High Stocking Reference is defined as 80 percent of the highest value for above-ground standing live carbon stocks per acre within the Project Area during the preceding 10-year period. To determine the High Stocking Reference, the Forest Owner must document changes in the Project Area's above-ground standing live carbon stocks over the preceding 10 years, or for as long as the Forest Owner has had control of the stocks, whichever is shorter. Figure 6.7 presents a graphical portrayal of a High Stocking Reference determination

CP = Common Practice (as determined in Step 1)

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 2)

WCS = The weighted average above-ground standing live carbon stocks per acre for all Forest Owner (and affiliate) landholdings within the same logical management unit as the Project Area. See Section 6.2.1.1 for requirements and guidance on calculating WCS

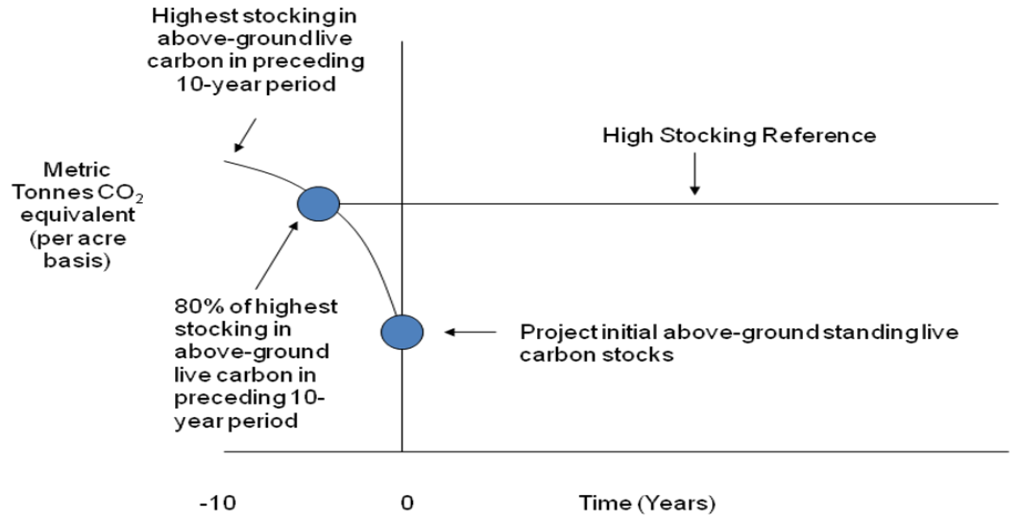


Figure 6.7. Determining a Project Area's High Stocking Reference
* It is possible for the High Stocking Reference to be higher than Common Practice, even where initial live-tree carbon stocks for the project are below Common Practice.

Step 4 – Determine the Baseline for All Onsite Carbon Pools

Once the baseline for above-ground standing live carbon stocks has been determined, perform the following steps:

1. Estimate baseline carbon stocks for all other required and optional *onsite* carbon pools identified for the project (including below-ground carbon stocks, as well as standing and lying dead carbon stocks where applicable). These carbon stocks must be modeled or estimated following the requirements and guidance in Appendix A and Appendix B. Carbon in harvested wood products is *not* included, since this is accounted for separately (Section 6.2.3).
2. Average the results, so that the baseline for other carbon pools contains the same (average) value for carbon stocks in every year.
3. Sum the above-ground standing live carbon stock baseline and the baseline for all other carbon stocks to produce a final baseline for all carbon pools (see Figure 6.8).

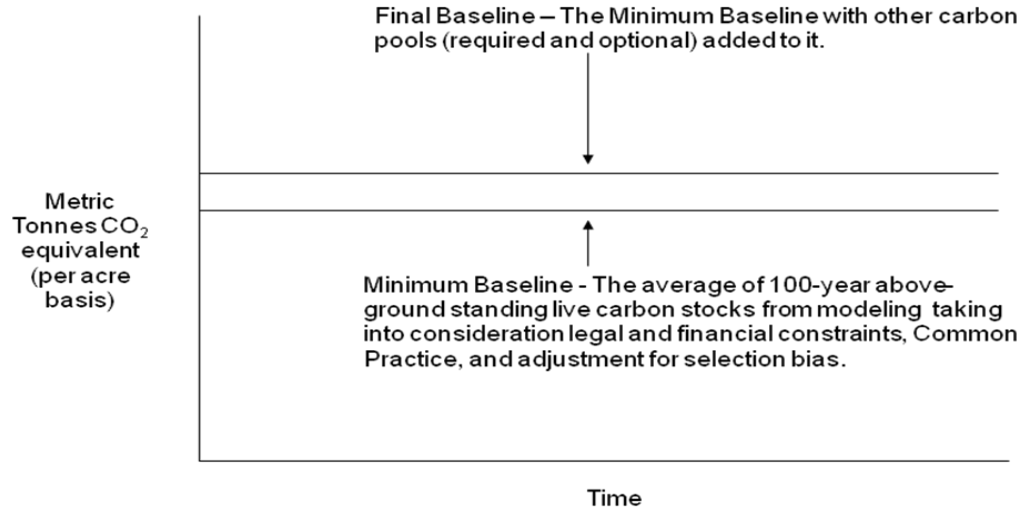


Figure 6.8. Final Baseline Incorporating All Required and Optional Carbon Stocks

6.2.1.1 Determining Weighted Average Carbon Stocks (WCS) on Lands in the Same Logical Management Unit as the Project Area

Determining the minimum baseline level (MBL) for an Improved Forest Management project requires a comparison to carbon stocking levels on other lands within the same logical management unit (LMU) as the Project Area. The carbon stocking level within the LMU (expressed as the weighted average above-ground standing live carbon stocks per acre for all lands in the same LMU) is used as a parameter (WCS) for determining the MBL in Equation 6.5 and Equation 6.6.

A “logical management unit” or “LMU” is defined as all land that the Forest Owner and its affiliate(s) (as defined below) either own in fee or hold timber rights on, and which it or they manage as an explicitly defined planning subunit. LMUs are generally characterized by having unique biological, geographical, and/or geological attributes, are generally delimited by watershed boundaries and/or elevational zones, and contain unique road networks. In addition, an LMU must:

- Be a sustainable planning subunit as demonstrated by inventory reports and growth and harvest projections for the LMU.
- Demonstrate that the proportion of the LMU harvested in the past 10 years (averaged for either volume or area on an annual basis) is within 20% of the annualized area or volume projected for harvest (a valid projection must be between 10 years and 30 years). If the LMU was acquired less than 10 years previously, the demonstration must include whatever history exists and extend out 20 to 30 years.
- Where uneven aged management is utilized, have between 33% and 66% of the forested stands exceeding the retention standards identified in the growth and harvest projections by a minimum of 25% (basal area).

An “affiliate” is defined as any person or entity that, directly or indirectly, through one or more intermediaries, controls or is controlled by or is under common control with the Forest Owner, including any general or limited partnership in which the Forest Owner is a partner and any limited liability company in which the Forest Owner is a member. For the purposes of this definition, "control" means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a person, whether through the ownership of voting

securities, by contract or otherwise, and "person" means an individual or a general partnership, limited partnership, corporation, professional corporation, limited liability company, limited liability partnership, joint venture, trust, business trust, cooperative or association or any other legally-recognized entity.

If an explicit, existing LMU containing the Project Area cannot be identified, the Forest Owner must define the LMU by identifying all lands where the Forest Owner and its affiliate(s) (as defined above) either own in fee or hold timber rights on within the same Assessment Area(s) covered by the Project Area. Assessment Areas covered by the Project Area are identified in Step 1, above, following the guidance in Appendix F.

To calculate WCS, the Forest Owner must estimate the above-ground standing live carbon stocks per acre for the entire LMU containing the Project Area (including the Project Area itself). This can be done using either existing inventory data, or a stratified vegetation-type analysis.

6.2.1.1.1 Calculating WCS Using Inventory Data

If sufficient inventory data for LMU lands exist to quantify above-ground standing live carbon stocks for the entire LMU, then the formula in Equation 6.7 may be used to calculate WCS.

Equation 6.7. Formula for WCS Using Inventory Data

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| \leq 0.2, then\ WCS = ICS$$

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| > 0.2, then\ WCS = \frac{ICS \cdot PA + ECS \cdot EA}{PA + EA}$$

Where,

WCS = The weighted average above-ground standing live carbon stocks per acre within the LMU containing the Project Area

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area

PA = Size of the Project Area in acres

ECS = Above-ground standing live carbon stocks per acre within the LMU *but excluding the Project Area* (EA), as determined from existing inventory data

EA = Size of the LMU in acres, e*xcluding the Project Area*

6.2.1.1.2 Calculating WCS Using Stratified Vegetation-Type Analysis

Forest Owners that do not have sufficient inventory data for the LMU must conduct a stratified vegetation-type analysis to calculate WCS. To conduct this analysis, all landholdings within the LMU – including the Project Area – must be divided into vegetation types and size class/canopy cover categories as delimited in Table 6.2, with a resolution for classification no greater than 40 acres. Each vegetation class has a "carbon rating" provided by the Reserve in Table 6.2. WCS must be calculated using the ratio of average carbon stocking on LMU lands relative to carbon

stocking on Project Area lands (referred to as the "stratified carbon weighting factor" or SWF). The required formulas are specified in Equation 6.8 and Equation **6.9**.

Equation 6.8. Formula for WCS Using Stratified Vegetation-Type Analysis

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| \leq 0.2, then\ WCS = ICS$$

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| > 0.2, then\ WCS = \frac{ICS \cdot PA + SWF \cdot ICS \cdot EA}{PA + EA}$$

Where,

WCS = The weighted average above-ground standing live carbon stocks per acre within the LMU containing the Project Area

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area

PA = Size of the Project Area in acres

SWF = The stratified carbon weighting factor for the LMU (from Equation **6.9** below)

EA = Size of the LMU in acres, e*xcluding the Project Area*

Equation 6.9. Formula for LMU Stratified Carbon Weighting Factor

$$SWF = \frac{\sum_i (PA_i \cdot CR_i)}{\sum_i PA_i} \div \frac{\sum_i (EA_i \cdot CR_i)}{\sum_i EA_i}$$

Where,

PA_i = Acres of the Project Area in forest vegetation type *i* (from Table 6.2)

EA_i = Acres of the LMU, e*xcluding the Project Area,* in forest vegetation type *i* (from Table 6.2)

CR_i = Carbon rating for forest vegetation type *i* (from Table 6.2)

Table 6.2. Vegetation Classes for Stratification

Forest Vegetation Description	Average Diameter (Breast Height)	Average Canopy Cover	Carbon Rating (metric tonnes CO_2e)
Brush	0"	NA	0

Regeneration	3"	NA	0.5
Pole-sized trees	6" - 12"	< 33%	2
Pole-sized trees	6" - 12"	33% - 66%	4
Pole-sized trees	6" - 12"	>66%	6
Small Sawlogs	12" - 20"	< 33%	4
Small Sawlogs	12" - 20"	33% - 66%	8
Small Sawlogs	12" - 20"	>66%	12
Large Sawlogs	20" - 36"	< 33%	8
Large Sawlogs	20" - 36"	33% - 66%	16
Large Sawlogs	20" - 36"	>66%	24
Very Large Trees	>36"	< 33%	16
Very Large Trees	>36"	33% - 66%	32
Very Large Trees	>36"	>66%	48

6.2.1.2 Consideration of Legal Constraints

In modeling the baseline for standing live carbon stocks, the Forest Owner must incorporate all legal constraints that could affect baseline growth and harvesting scenarios. The standing live carbon stock baseline must represent a growth and harvesting regime that fulfills all legal requirements. Voluntary agreements that can be rescinded, such as rental contracts and forest certifications, are not legal constraints. Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) that are in place more than one year prior to the project's start date shall be modeled as legal constraints. HCPs and SHAs that are approved after the date one year prior to the project's start date are not considered legal constraints for the purpose of baseline modeling and may be disregarded.

Legal constraints include all laws, regulations, and legally-binding commitments applicable to the Project Area at the time of the project's initiation that could affect standing live carbon stocks. Legal constraints include:

1. Federal, state/provincial, or local government regulations that are required and might reasonably be anticipated to influence carbon stocking over time including, but not limited to:
    a. Zones with harvest restrictions (e.g. buffers, streamside protection zones, wildlife protection zones)
    b. Harvest adjacency restrictions
    c. Minimum stocking standards
2. Forest practice rules, or applicable Best Management Practices established by federal, state, provincial or local government that relate to forest management.
3. Other legally binding requirements affecting carbon stocks including, but not limited to, covenants, conditions and restrictions, and other title restrictions in place prior to or at the time of project initiation, including pre-existing conservation easements, Habitat Conservation Plans, Safe Harbor Agreements, and deed restrictions, excepting an encumbrance that was put in place and/or recorded less than one year prior to the project start date, as defined in Section 3.6.

For Forest Projects located in California, the baseline must be modeled to reflect all silvicultural treatments associated with timber harvest plans (THPs) active within the Project Area at the time of the project's initiation. All legally enforceable silvicultural and operational provisions of a THP – including those operational provisions designed to meet California Forest Practice Rules requirements for achieving Maximum Sustained Production of High Quality Wood Products [14

CCR 913.11 (933.11, 953.11)] – are considered legal constraints and must be reflected in baseline modeling for as long as the THP will remain active. For portions of the Project Area not subject to THPs (or over time periods for which THPs will not be active), baseline carbon stocks must be modeled by taking into account any applicable requirements of the California Forest Practice Rules and all other applicable laws, regulations, and legally binding commitments that could affect onsite carbon stocks. On a case-by-case basis, the California Department of Forestry and Fire Protection (Cal FIRE) may assist Forest Owners in identifying minimum carbon stocking levels that would be effectively required under California Forest Practice Rules.

6.2.1.3 Consideration of Financial Constraints

In modeling the baseline for standing live carbon stocks, the Forest Owner must incorporate financial constraints that could affect baseline growth and harvesting scenarios. The Forest Owner must demonstrate that the growth and harvesting regime assumed for the baseline is financially feasible through one of the following means:

1. A financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints. Cost and revenue variables in the financial analysis may be based on regional norms or on documented costs and returns for the Project Area or other properties in the project's Assessment Area.
2. Providing evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years. The evidence must demonstrate that harvesting activities have taken place on at least one other comparable site with:
    a. Slopes that do not exceed slopes in the Project Area by more than 10 percent;
    b. An equivalent zoning class to the Project Area
    c. Comparable species composition to the Project Area (i.e. within 20% of project species composition based on trees per acre)
    d. Similar access by road, cable, or helicopter

6.2.2 Estimating Baseline Onsite Carbon Stocks – Public Lands

For Improved Forest Management Projects on lands owned or controlled by public agencies, the baseline must be estimated by:

1. Conducting an initial forest carbon inventory for the Project Area
2. Projecting future changes to Project Area forest carbon stocks by:
    a. Extrapolating from historical trends
    b. Anticipating how current and future public policy will affect onsite carbon stocks

The method that results in the highest estimated carbon stock levels must be used to determine the baseline.

To extrapolate from historical trends:

- For Project Areas that have a ten-year history of declining carbon stocks, the baseline must be defined by the average of the carbon stocks over the past ten years and considered static for the project life (i.e. the same level of carbon stocks is assumed in every year).
- For Project Areas that demonstrate an increasing inventory of carbon stocks over the past ten years, the growth trajectory of the baseline shall continue until the forest (under the baseline stocks) achieves a stand composition consistent with comparable forested areas that have been relatively free of harvest over the past 60 years.

To anticipate how current and future public policy will affect onsite carbon stocks, the baseline must be modeled following the guidance in Appendix B incorporating constraints imposed by all applicable statutes, regulations, policies, plans and Activity-Based Funding.

6.2.3 Estimating Baseline Carbon in Harvested Wood Products

To estimate the amount of baseline carbon transferred to long-term storage in wood products each year, the following steps must be performed:

1. Determine the *average* amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year of the baseline over 100 years. The result will be a uniform estimate of harvested carbon in each year of the baseline. This estimate is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.
    a. For projects on private lands, the amount of harvested carbon must be derived from the growth and harvesting regime used to develop the baseline for onsite carbon stocks in Section 6.2.1.
    b. For projects on public lands, the amount of harvested carbon must be derived from the growth and harvesting regime assumed in the baseline for onsite carbon stocks derived in Section 6.2.2.
2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.2.4 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Improved Forest Management Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in Appendix B. Guidance for projecting forest inventory plot data using models is also provided in Appendix B.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in Appendix A, Section A.4.

6.2.5 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.2.4).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.2.6 Quantifying Secondary Effects

For Improved Forest Management Projects, significant Secondary Effects can occur if a project reduces harvesting in the Project Area, resulting in an increase in harvesting on other properties. Changes in energy-related emissions, which could result from a Forest Project

causing consumers of forest products to increase or decrease their use of alternative materials, are not accounted for because it is assumed that energy sector emissions will be capped in the relatively near future under a regulatory cap-and-trade system.

Equation 6.10 must be used to estimate Secondary Effects for Improved Forest Management Projects.

Equation 6.10. Secondary Effects Emissions

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) > 0, then\ SE_y = 0$$

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) < 0, then\ SE_y = (AC_{hv,y} - BC_{hv,y}) \times 20\%$$

Where,

SE_y = Estimated annual Secondary Effects (used in Equation 6.1)

$AC_{hv, n}$ = Actual amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tonnes

$BC_{hv, n}$ = Estimated average baseline amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tonnes, as determined in Step 1 of Section 6.2.3

y = The current year or reporting period

6.3 Avoided Conversion Projects

6.3.1 Estimating Baseline Onsite Carbon Stocks

The baseline for Avoided Conversion Projects is a projection of onsite forest carbon stock losses that would have occurred over time due to the conversion of the Project Area to a non-forest land use. Estimating the baseline for Avoided Conversion Projects involves two steps:

1. Characterizing and projecting the baseline
2. Discount for the uncertainty of conversion probability

Step 1 - Characterizing and Projecting the Baseline

Forest Owners must characterize and project the baseline by:

1. Clearly specifying an alternative highest-value land use for the Project Area, as identified by an appraisal (required in Section 3.1.2.3).
2. Estimating the rate of conversion and removal of onsite carbon stocks. The rate of conversion and removal of onsite carbon stocks must be estimated by either:
    a. Referencing planning documentation for the Project Area (e.g. construction documents or plans) that specifies the timeframe of the conversion and intended removal of forest cover on the Project Area; or

   b. In the absence of specific documentation, identifying a default annual conversion rate from Table 6.3.
3. Using a computer simulation to project changes in onsite carbon stocks over 100 years, reflecting the rate of conversion estimated in (2). The simulation must model changes in onsite carbon stocks for all required and selected optional carbon pools, as identified in Section 5.3.

Table 6.3. Default Avoided Conversion Rates

Type of Conversion Identified in Appraisal	Total Conversion Impact	Annual Rate of Conversion
	This is the assumed total effect over time of the conversion activity. (The total conversion impact is amortized over a 10-year period to determine the annual rate of conversion in the next column.)	This is the assumed annual rate of the conversion activity. The percentages below are multiplied by the initial onsite carbon stocks for the project on an annual basis for the first 10 years of the project.
Residential	Estimate using the following formula: TC = 3 / A *Where:* TC = % total conversion (TC cannot exceed 100%) A = the parcel sizes (the number of unique ownerships that would be formed on the property as identified in the appraisal) identified in the appraisal (acres)	Estimate using the following formula: ARC = TC / 10 *Where:* ARC = % annual rate of conversion TC = % total conversion
Mining and agricultural conversion, including pasture or crops	90%	9.0%
Golf course	80%	8.0%
Commercial buildings	95%	9.5%

The computer simulation of the baseline must apply the identified rate of conversion over time to estimate changes in onsite carbon stocks, beginning with the Project Area's initial onsite carbon stocks.

If the projected conversion rate does not result in a complete removal of onsite forest carbon stocks, the baseline projection should account for any residual forest carbon value as a steady condition for the balance of a 100-year projection. See Figure 6.11 for an example of a projected baseline for a hypothetical project that avoids residential conversion, using an appropriate conversion rate from Table 6.2.

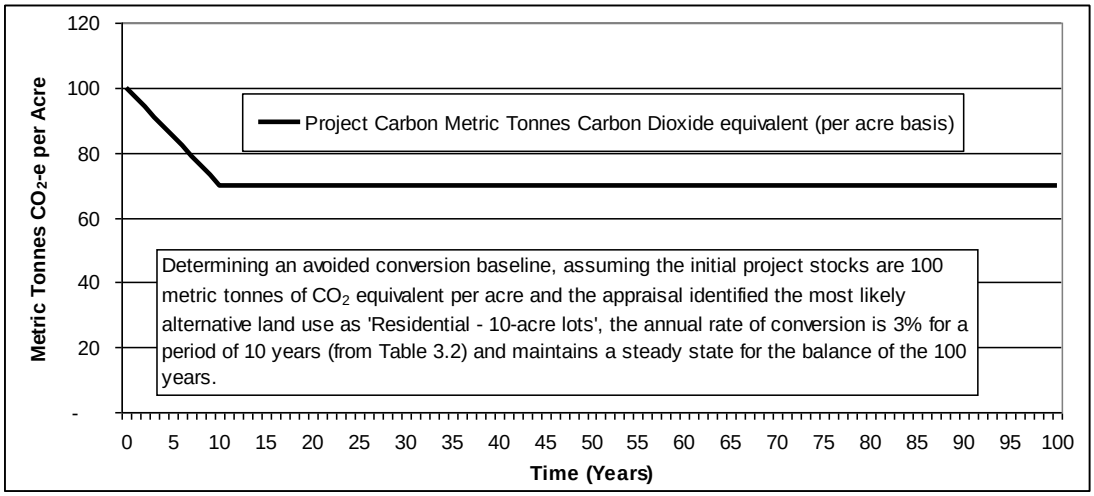


Figure 6.9. Example of a Project Avoided Conversion Project Baseline

Step 2 - Discount for Uncertainty of Conversion Probability

If the fair market value of the anticipated alternative land use for the Project Area (as determined by the appraisal required in Section 3.1.2.3) is *not more than 80 percent greater* than the value of the current forested land use, then a discount must be applied each year to the project's quantified GHG reductions and removals. If quantified GHG reductions and removals for the year are positive (i.e. $[(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,\,y} – BC_{wp,\,y}) \times 80\% + SE_y] > 0$ in Equation 6.1.) then use the following formula (Equation 6.11) to calculate the appropriate Avoided Conversion Discount factor, ACD. If quantified GHG reductions and removals for the year are negative, then ACD must equal zero.

Equation 6.11. Avoided Conversion Discount Factor

If $0.4 < ((VA / VP) – 1) < 0.8$, **then** $ACD = [80\% – ((VA / VP) – 1)] \times 2.5$
If $((VA / VP) – 1) > 0.8$, **then** $ACD = 0\%$
If $((VA / VP) – 1) < 0.4$, **then** $ACD = 100\%$

Where,

ACD = The Avoided Conversion Project discount factor (used in Equation 6.1)

VA = The appraised fair market value of the anticipated alternative land use for the Project Area

VP = The appraised fair market value of the current forested land use for the Project Area

6.3.2 Estimating Baseline Carbon in Harvested Wood Products

Harvesting is assumed to occur in the baseline over time as the Project Area is converted to another land use. To estimate the baseline carbon transferred to long-term storage in harvested wood products each year:

1. Determine the amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year, consistent with the rate of reduction in

baseline standing live carbon stocks determined in Section 6.3.1. This projection is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.

2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.3.3 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Avoided Conversion Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in Appendix B. Guidance for projecting forest inventory plot data using models is also provided in Appendix B.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in Appendix A, Section A.4.

6.3.4 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.3.3).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in Appendix C.

6.3.5 Quantifying Secondary Effects

Significant Secondary Effects for Avoided Conversion Projects can arise if the type of land use conversion that would have happened on the Project Area is shifted to other forest land.

To quantify Secondary Effects for Avoided Conversion Projects, Forest Owners must quantify Secondary Effect emissions using Equation 6.12. The value for Secondary Effect emissions will always be negative or zero.

Equation 6.12. Secondary Effects Emissions

$$\mathbf{SE_y = (-1) \times 3.6\% \times (\Delta\ AC_{onsite} - \Delta\ BC_{onsite})}$$ or **0**, whichever is lower

Where,

SE_y = Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1)
$\Delta\ AC_{onsite}$ = Annual difference in actual onsite carbon (CO_2e) as defined in Equation 6.1
$\Delta\ BC_{onsite}$ = Annual difference in baseline onsite carbon (CO_2e) as defined in Equation 6.1

Table 6.4. Example of Annual GHG Reduction/Removal Calculations for an Improved Forest Management Project

		Year						
		0	1	2	3	4	5	Notes
	Calculating GHG Reductions/Removals for Onsite Carbon Stocks							
1	Actual Onsite Carbon Stocks (tonnes CO2e)	80.00	82.00	85.00	88.00	92.00	96.00	This is the total carbon in all reported pools within the Project Area, reported as a best estimate, regardless of statistical confidence.
2	Confidence Deduction	10%	10%	10%	5%	5%	0%	The confidence deduction is based on the sampling error of the combined estimate of carbon in all onsite carbon pools (Appendix A, Section A.4). In this example, sampling error is progressively reduced in years 3-5, leading to a lower confidence deduction.
3	Adjusted Actual Onsite Carbon Stocks (adjusted for confidence deduction)	72.00	73.80	76.50	83.60	87.40	96.00	Actual onsite carbon stocks adjusted using the confidence deduction.
4	Annual Increment in Actual Onsite Carbon Stocks (tonnes CO2e)	72.00	1.80	2.70	7.10	3.80	8.60	Difference from prior year (Δ AC_{onsite}). In year 1, prior year stocks are assumed to be zero, so difference is equal to initial adjusted onsite carbon stocks.
5	Baseline Onsite Carbon Stocks (tonnes CO2e)	80.00	80.00	80.00	80.00	80.00	80.00	Baseline estimates of onsite carbon stocks are not affected by the confidence deduction. Baseline carbon stocks are determined from an initial inventory and are modeled thereafter.
6	Annual Increment in Baseline Onsite Carbon Stocks (tonnes CO2e)	80.00	0.00	0.00	0.00	0.00	0.00	Difference from prior year (Δ BC_{onsite}). In year 1, prior year stocks are assumed to be zero, so difference is equal to initial (unadjusted) onsite carbon stocks.
7	Quantified GHG Reductions / Removals for Onsite Carbon Stocks (tonnes CO2e)	-8.00	1.80	2.70	7.10	3.80	8.60	Difference from prior year (Δ AC_{onsite} - Δ BC_{onsite}). May be negative, which would indicate that a reversal has occurred if credits were issued in any previous year. If no CRTs have been issued previously, then any negative amount is added to the "negative carryover" to subsequent years (row 18).
	Accounting for Carbon Stored in Wood Products							
8	Actual Carbon in Trees Harvested for Wood Products in (tonnes CO2e)	1.00	1.00	3.00	4.00	0.00	1.00	Based on actual carbon in standing live carbon stocks harvested in each year, prior to delivery to mills.
9	Carbon in Trees Harvested for Wood Products in Baseline (tonnes CO2e)	3.00	3.00	3.00	3.00	3.00	3.00	Based on estimated carbon in standing live carbon stocks harvested each year in the baseline, prior to delivery to mills.
10	Actual Carbon Stored Long-term in Wood Products (tonnes CO2e)	0.27	0.27	0.69	0.92	0.00	0.27	Calculated in Appendix C using actual harvested carbon values. If actual harvest volumes for the year are less than baseline harvest volumes, then this value will include carbon stored long-term in landfills.
11	Baseline Carbon Stored Long-term in Wood Products (tonnes CO2e)	0.81	0.81	0.69	0.69	0.81	0.81	Calculated in Appendix C using baseline harvested carbon values. If actual harvesting volumes for the year are less than baseline harvesting volumes, then this value will include carbon stored long-term in landfills.
12	Difference in Actual and Baseline Carbon Stored in Wood Products (tonnes CO2e)	-0.54	-0.54	0.00	0.23	-0.81	-0.54	Difference between actual and baseline carbon stored long-term in wood products in each year ($AC_{wp,\,y}$ – $BC_{wp,\,y}$). May be negative.
13	Multiplied by 80% Market Response Factor	-0.43	-0.43	0.00	0.18	-0.65	-0.43	The difference is multiplied by 80% to account for market responses to changes in wood product production (see discussion below Equation 6.1).
14	Quantified GHG Reductions / Removals for Carbon Stored in Wood Products (tonnes CO2e)	-0.43	-0.43	0.00	0.18	-0.65	-0.43	Equal to ($AC_{wp,\,y}$ – $BC_{wp,\,y}$) * 80%. May be negative.
	Accounting for Secondary Effects							
15	Difference Between Actual and Baseline Carbon in Harvested Wood (tonnes CO2e)	-2.00	-2.00	0.00	1.00	-3.00	-2.00	The difference between the values in rows (8) and (9), above.
16	Secondary Effect Adjustment (tonnes CO2e)	-0.40	-0.40	0.00	0.00	-0.60	-0.40	Either zero, if the value in row 15 is positive, or 20% of the value in row 15 if it is negative. See Section 6.2.6. This example shows the calculation of SEy for Improved Forest Management Projects. For other project types, different methods and factors are used to calculate SEy.
	Calculation of Total Net GHG Reductions/Removals and Buffer Pool Contribution							
17	Avoided Conversion Project Discount Factor	0.00	0.00	0.00	0.00	0.00	0.00	Not relevant for an Improved Forest Management or ReforestationProject .
18	Negative Carryover from Prior Year (tonnes CO2e)	0.00	-8.83	-7.86	-5.16	0.00	0.00	This is any negative amount from the prior year's total net GHG reductions/removals that is **not** due to a reversal.
19	Total Net GHG Reductions/Removals (tonnes CO2e)	-8.83	-7.86	-5.16	2.12	2.55	7.77	Equal to the sum of the values in rows 7, 14, 16, and 18. (The "avoided conversion project discount factor" in row 17 may be ignored for Improved Forest Management Projects.)
20	Total CRTs Issued	0.00	0.00	0.00	2.00	2.00	7.00	Total number of CRTs the Reserve will issue for quantified GHG reductions/removals. CRTs are not issued for partial tonnes.
21	Risk of Reversal %	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	This value is determined by completing a risk analysis in line with the requirements in Appendix D.
22	Required Buffer Pool Contributions (CRTs)	-	-	-	1.00	1.00	1.00	The number of CRTs that must be contributed to the Buffer Pool each year, based on the risk of reversal. Calculated by mutliplying the the total net GHG reductions/removals (row 19) by the risk percentage (row 21). Any remainder must be rounded up.
23	CRTs Issued to Project	-	-	-	1.00	1.00	6.00	Total CRTs issued to the project in each year.

	Data entered by Forest Owner at each verification
	Data entered by Forest Owner at time project is registered
	Data calculated automatically

7 Ensuring the Permanence of Credited GHG Reductions and Removals

The Reserve requires that credited GHG reductions and removals be effectively "permanent." For Forest Projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.

The Reserve ensures the permanence of GHG reductions and removals through three mechanisms:

1. The requirement for all Forest Owners to monitor onsite carbon stocks, submit regular monitoring reports, and submit to regular third-party verification of those reports along with periodic verification site visits (as detailed in Sections 8 through 10 of this protocol) for the duration of the Project Life.
2. The requirement for all Forest Owners to sign a Project Implementation Agreement with the Reserve, as described in Section 3.5, which obligates Forest Owners to retire CRTs to compensate for reversals of GHG reductions and removals.
3. The maintenance of a Buffer Pool to provide insurance against reversals of GHG reductions and removals due to unavoidable causes (including natural disturbances such a fires, pest infestations or disease outbreaks).

GHG reductions and removals can be "reversed" if the stored carbon associated with them is released (back) to the atmosphere. Many biological and non-biological agents, both natural and human-induced, can cause reversals. Some of these agents cannot completely be controlled (and are therefore "unavoidable"), such as natural agents like fire, insects, and wind. Other agents can be controlled, such as the human activities like land conversion and over-harvesting. Under this protocol, reversals due to controllable agents are considered "avoidable". As described in this section, Forest Owners are required to identify and quantify the risk of reversals from different agents based on project-specific circumstances. The resulting risk rating determines the quantity of Climate Reserve Tonnes (CRTs) that the project must contribute to the Reserve Buffer Pool to insure against reversals.

7.1 Definition of a Reversal

Project owners must demonstrate, through annual reporting and periodic site-visit verification, that stocks associated with credited GHG reductions and removals are maintained for a period of time considered to be permanent (i.e. 100 years). If the quantified GHG reductions and removals (i.e. QR_y in Equation 6.1) in a given year are negative, and CRTs were issued to the Forest Project in any previous year, the Reserve will consider this to be a reversal regardless of the cause of the decrease. Planned thinning or harvesting activities, for example, may cause a reversal if they result in a negative value for QR_y.

7.2 Insuring Against Reversals

The Reserve requires Forest Owners to insure against reversals, based on a project-specific risk evaluation. Currently, insurance must take the form of contributing CRTs to the Buffer Pool administered by the Reserve. In the future, the Reserve anticipates that other insurance instruments may be available to insure against reversals.

7.2.1 About the Buffer Pool

The Buffer Pool is a holding account for Forest Project CRTs, which is administered by the Reserve. All Forest Projects must contribute a percentage of CRTs to the Buffer Pool any time they are issued CRTs for verified GHG reductions and removals. Each Forest Project's contribution is determined by a project-specific risk rating, as described in Section 7.2.2. If a Forest Project experiences an unavoidable reversal of GHG reductions and removals (as defined in Section 7.3), the Reserve will retire a number of CRTs from the Buffer Pool equal to the total amount of carbon that was reversed (measured in metric tons of CO_2-equivalent). The Buffer Pool therefore acts as a general insurance mechanism against unavoidable reversals for all Forest Projects registered with the Reserve.

7.2.2 Contributions to the Buffer Pool

Each time the Reserve issues CRTs for verified GHG reductions and removals achieved by a Forest Project, a certain percentage of those CRTs must be contributed to the Buffer Pool. The size of the contribution to the Buffer Pool will depend on the Forest Project's risk rating for reversals. For example, if a Forest Project is issued 10 CRTs after annual verification, and the project's reversal risk rating is 10 percent, then 9 CRTs will be issued to the Forest Owner's Reserve account and 1 CRT must be deposited in the Buffer Pool.

Forest Owners must determine the reversal risk rating for a project by following the requirements and guidance in Appendix D. The risk rating must be determined prior to registration, and recalculated in every year the project undergoes a verification site visit (see Section 10.3.2).

Forest Owners who record a conservation easement or deed restriction in conjunction with implementing a Forest Project will receive a lower risk rating (see Appendix D).

Forest Owners may be able to reduce the risk rating through actions that lower the risk profile of their project. If a Forest Project's risk rating declines, the Reserve may distribute previously withheld Buffer Pool CRTs to the Forest Owner in proportion to the reduced risk. Similarly, however, the Reserve may require additional contributions to the Buffer Pool if the risk rating increases, to ensure that all CRTs (including those issued in prior years) are properly insured.

7.2.3 Other Insurance Options for Reversals

It is the Reserve's expectation that other options to insure against reversals will develop for projects in the future. These options may include direct insurance. Alternative insurance mechanisms could be used to directly reduce the required Buffer Pool contributions for a project. The Reserve must review and approve alternative insurance mechanisms before they may be used.

7.3 Compensating for Reversals

The Reserve requires that all reversals be compensated through the retirement of CRTs. If a reversal associated with a Forest Project was unavoidable (as defined below), then the Reserve will compensate for the reversal on the Forest Owner's behalf by retiring CRTs from the Buffer Pool. If a reversal was avoidable (as defined below) then the Forest Owner must compensate for the reversal by surrendering CRTs from its Reserve account.

7.3.1 Unavoidable Reversals

An Unavoidable Reversal is any reversal not due to the Forest Owner's negligence, gross negligence or willful intent, including wildfires or disease that are not the result of the Forest Owner's negligence, gross negligence or willful intent. Requirements for Unavoidable Reversals are as follows:

1. If the Forest Owner determines there has been an Unavoidable Reversal, it must notify the Reserve in writing of the Unavoidable Reversal within six months of its occurrence.
2. The Forest Owner must explain the nature of the Unavoidable Reversal and provide a verified estimate of onsite carbon stocks within one year so that the reversal can be quantified (in units of CO_2-equivalent metric tons).

If the Reserve determines that there has been an Unavoidable Reversal, it will retire a quantity of CRTs from the Buffer Pool equal to size of the reversal in CO_2-equivalent metric tons (i.e. QR_y, as specified in Equation 6.1).

7.3.2 Avoidable Reversals

An Avoidable Reversal is any reversal that is due to the Forest Owner's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the Project Area due to the Forest Owner's negligence, gross-negligence or willful intent. Requirements for Avoidable Reversals are as follows:

1. If an Avoidable Reversal has occurred, the Forest Owner must give written notice to the Reserve within thirty days. Additionally, if the Reserve determines that an Avoidable Reversal has occurred, it shall deliver written notice to the Forest Owner.
2. Within thirty days of receiving the avoidable reversal notice from the Reserve, the Forest Owner must provide a written description and explanation of the reversal to the Reserve.
3. Within three months of receiving the avoidable reversal notice, the Forest Owner must provide the Reserve with a verified estimate of current onsite carbon stocks;
4. Within four months of receiving the avoidable reversal notice, the Forest Owner must retire a quantity of CRTs from its Reserve account equal to the size of the reversal in CO_2-equivalent metric tons (i.e. QR_y, as specified in Equation 6.1). In addition:
    a. The retired CRTs must be those that were issued to the Forest Project, or that were issued to other Forest Projects registered with the Reserve.
    b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.

7.4 Disposition of Forest Projects after a Reversal

If a reversal lowers the Forest Project's actual standing live carbon stocks below its approved baseline standing live carbon stocks, the Forest Project will automatically be terminated. (In this circumstance, the original approved baseline for the project would no longer be valid.) If the Forest Project is automatically terminated due to an Unavoidable Reversal, another project may be initiated and submitted to the Reserve for registration on the same Project Area. New projects may not be initiated on the same Project Area if the Forest Project is terminated due to an Avoidable Reversal.

If the Forest Project has experienced a reversal and its actual standing live carbon stocks are still above the approved baseline levels, it may continue without termination as long as the reversal has been compensated. The project must continue contributing to the Buffer Pool in future years based on its verified risk rating.

8 Project Monitoring

Monitoring is the process of regularly collecting and reporting data related to a project's performance. Annual monitoring of Forest Projects is required to ensure up-to-date estimates of project carbon stocks and provide assurance that GHG reductions or removals achieved by a project have not been reversed. Forest Owners must conduct monitoring activities and submit monitoring reports according to the schedule and requirements presented in Section 9.3). Monitoring is required for a period of 100 years following the final issuance of CRTs to a project for quantified GHG reductions or removals.

For Forest Projects, monitoring activities consist primarily of updating a project's forest carbon inventory. The Reserve requires a complete inventory of carbon stocks to be reported each year. This complete inventory must be maintained throughout the time the project is reporting to the Reserve.

8.1 Monitoring Plans

Prior to a Forest Project's first verification, the Forest Owner must establish a monitoring plan detailing the specific methods that will be used to update the project's forest carbon inventory on an annual basis. The inventory methodology detailed in this monitoring plan must adhere to the guidance in Appendix A and B, which establish the equations for computing biomass and limits to which computer models can be used in the inventory update process.

8.2 Monitoring Requirements

Forest Owners are required to report the Forest Project's onsite carbon stocks each reporting period. Monitoring reports must include an estimate of carbon stocks in all required and optional carbon pools. The estimate must reflect the appropriate confidence deduction as determined by the steps in Appendix A, Section A.4. Onsite carbon stock estimates are computed from inventory data. Inventory data are updated by:

1. Incorporating any new forest inventory data obtained during the reporting period.
2. Modeling growth in sample plots using approved growth models and stand table projection methods (see Appendix B regarding growth models and stand table projections).
3. Updating the forest inventory data for harvests and/or disturbances that have occurred during the reporting period.

Specific methods used to update the forest inventory must follow the inventory methodology approved at the time the project is registered. Modifications to inventory methodologies must be approved in advance by a third-party verification body and by the Reserve.

9 Reporting Parameters

This section provides requirements and guidance on reporting rules and procedures.

9.1 Project Documentation

Forest Owners must provide the following documentation to the Reserve in order to register a forest project.

- Project Submittal form
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form
- Verification Report
- Verification Opinion
- Project Implementation Agreement

Forest Owners must provide the following documentation each time a Forest Project is verified in order for the Reserve to issue CRTs for quantified GHG reductions.

- Verification Report
- Verification Opinion
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form (Improved Forest Management projects only)

At a minimum, the above project documentation will be available to the public via the Reserve's online registry. Further disclosure and other documentation may be made available on a voluntary basis through the Reserve. Project submittal forms can be found at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

All reports that reference carbon stocks must be submitted with the oversight of a Professional Forester. If the project is located in a jurisdiction without a Professional Forester law or regulation, then Certified Forester credentials managed by the Society of American Foresters (see www.certifiedforester.org) are required so that professional standards and project quality are maintained. The Reserve may evaluate and approve alternative certification credentials if requested, but only for jurisdictions where professional forester laws or regulations do not exist. This requirement does not preclude the project's use of technicians or other unlicensed/uncertified persons working under the supervision of the Professional Forester.

All documents and forms related to the project must be retained by the Forest Owner for a minimum of 100 years after the final issuance of CRTs from the Reserve. This information may be requested by the verification body or the Reserve at any time.

9.1.1 Forest Project Design Document

The Forest Project Design Document is a standard document for reporting required information about a project. The document is submitted at the initial verification. The following information must be reported in the Forest Project Design Document.

9.1.1.1 All Projects

Reforestation Projects, as qualified in Section 6.1.1, can defer the items that are marked with an asterisk until the second site-visit verification):

1. An explanation and justification of the project start date.
2. Declaration that the project does *not* employ broadcast fertilization.
3. If the Forest Project is located on public land, a description and copies of the documentation demonstrating explicit approval of the project's management activities and baseline including any public vetting processes necessary to evaluate management and policy decisions concerning the project activity.
4. If the Forest Project is located in tribal areas, a description and copies of documentation demonstrating that the land within the Project Area is owned by a tribe or private entities.
5. If commercial harvesting is either planned or ongoing within the Project Area, a description of how the Forest Owner satisfies one of the three requirements for employing and demonstrating sustainable long-term harvesting practices on all of its forest landholdings (refer to Section 3.9.1).
6. A description of how the project meets (or will meet) the definition of "Natural Forest Management" (refer to Section 3.10.2), including required policies/statements of intent for management of lying and standing dead wood.
7. Descriptions and maps of the Project Area boundaries that include:
    a. Public and private roads (Map)
    b. Towns (Map)
    c. Major Watercourses (4^{th} order or greater) (Map)
    d. Topography (Map)
    e. Townships, Ranges, and Sections or Latitude and Longitude (Map)
    f. Existing land cover and land use (Description with Optional Map)
    g. Forest vegetation types (Description with Optional Map)
    h. Site classes (Description with Optional Map)
    i. Land pressures and climate zone/classification (Description with Optional Map)
8. *A description of the inventory methodology for each of the carbon pools included in the Forest Project's GHG Assessment Boundary. The inventory methodology must describe:
    a. The stratification rules and processes, if applicable.
    b. The sampling process, including selection of plot locations, monumenting of plots, frequency of sampling efforts, data gathering procedures, and parameters of data collected.
    c. Data management and analytical systems.
    d. An inventory monitoring plan including the annual inventory update processes, and the adjustments for harvest, growth, and disturbances over time.
    e. Methods for quality control.
9. *A description of the calculation methodologies for determining metric tons per hectare for each of the carbon pools included in the project report.
10. *A modeling plan, following the requirements in Appendix B, Section B.3.
11. A diagram of the final baseline incorporating all required and optional carbon stocks.
12. *A summary of the carbon stock inventory for the Forest Project by each carbon pool.
13. *A summary of inventory confidence statistics.
14. *The Forest Owner's description and estimate of the Forest Project's baseline onsite carbon stocks. Baseline onsite carbon stocks must be portrayed in a graph depicting time in the x-axis and carbon tonnes in the y-axis. The graph should be supported with

written characterizations that explain any annual changes in baseline carbon stocks over time. These characterizations must be consistent with the baseline analysis required in Section 6.

15. A description of the management activities that will lead to increased carbon stocks in the Project Area, compared to the baseline.
16. *
17. *The Forest Owner's estimate of carbon that will be stored long-term in harvested wood products in the baseline.
18. *Calculation of the project's reversal risk rating and contribution to the buffer pool.

9.1.1.2 Reforestation Projects

In addition to the information in Section 9.1.1.1, Forest Owners must provide the following information:

1. An explanation of how the project, at the time of project initiation, meets the eligibility requirements of a) less than 10 percent tree canopy cover for a minimum of 10 years; or b) subject to a significant disturbance that has removed at least 20 percent of the land's above-ground live biomass. The explanation should include why the forest was out of forest cover or a description of the disturbance if a natural significant disturbance occurred.
2. For a Reforestation Project that occurs on land that has undergone a recent Significant Disturbance, indicate the eligibility scenario pertaining to the project site as identified in Appendix E, or a description of how the Forest Project occurs on a type of land for which the Forest Owner has not historically engaged in or allowed timber harvesting.
3. A qualitative characterization of baseline conditions, including an assessment of the likely vegetative conditions and activities that would have occurred in the absence of the project, taking into consideration any laws, statutes, regulations, or other legal mandates that would encourage or require reforestation on the Project Area. The qualitative assessment shall include an assessment of the commercial value of trees within the project area over the next 30 years.

9.1.1.3 Improved Forest Management Projects on Private Lands

In addition to the information in Section 9.1.1.1, Forest Owners must provide the following information:

1. Documentation that the Project Area has greater than 10 percent tree canopy cover.
2. A determination of how the Forest Project's initial standing live carbon stocks compare to Common Practice, as required in Section 6.2.1.
3. If the Forest Project's initial standing live carbon stocks are below Common Practice, a determination of the "High Stocking Reference" for the Project Area. The High Stocking Reference is defined as 80 percent of the highest carbon stocks in live trees during the preceding 10-year period. To determine the High Stocking Reference, the Forest Owner must document changes in the Project Area's live-tree carbon stocks over the preceding 10 years, or as long as the Forest Owner has had control of the stocks. The summary report should include an affidavit testifying that the inventory depicted over the past 10 years is reasonably accurate. The affidavit must include a summary of volume harvested over the past 10 years.
4. Documentation of any and all legal constraints affecting forest management activities on the Project Area. The documentation of legal constraints must include:
    a. A description of each constraint (refer to Section 6.2.1.1).

   b. A narrative that describes the effect of the constraint on forest management.
   c. A description of the modeling techniques used to simulate the effects of the constraint.
5. A demonstration that the growth and harvesting regime assumed for the baseline is financially feasible following the requirements of Section 6.2.1.3.

9.1.1.4 Improved Forest Management Projects on Public Lands

In addition to the information in Section 9.1.1.1, Forest Owners must provide the following information:

1. Documentation demonstrating that the project takes place on land that has greater than 10 percent tree canopy cover.
2. A projection of future changes to Project Area forest carbon stocks by extrapolating from historical trends; and anticipating how current and future public policy will affect onsite carbon stocks per the requirements of Section 6.2.2.
3. An explanation of how current and future public policy will affect onsite carbon stocks and how, the baseline modeling incorporates constraints imposed by all applicable statutes, regulations, policies, plans and Activity-Based Funding.

9.1.1.5 Avoided Conversion Projects

In addition to the information in Section 9.1.1.1, Forest Owners must provide the following information at the time an Avoided Conversion Project is submitted for verification and registration:

1. Documentation demonstrating the planned or completed dedicating of the land in the Project Area to continuous forest cover through a conservation easement or transfer to public ownership.
2. Documentation demonstrating that the type of anticipated land use conversion is legally permissible per the requirements of Section 3.1.1.3.
3. A description of how the Project Area was determined, following the requirements in Section 4.
4. A full copy of the appraisal that was prepared for the Project Area per the requirements of Section 3.1.2.3.
5. A description of the highest value alternative land use identified in the appraisal.
6. An estimate the rate of conversion and removal of onsite carbon stocks per the requirements in Section 6.3.1.
7. A comparison of the fair market value of the anticipated alternative land use for the Project Area with the value of the current forested land use, and the calculation of an appropriate uncertainty discount (following the requirements in Section 6.3.1).

9.2 Monitoring Reports

A monitoring report must be prepared for each reporting period. Monitoring reports must be provided to verification bodies whenever a Forest Project undergoes verification. In addition, monitoring reports must be provided to the Reserve upon the completion of any reporting period for which verification will be deferred (e.g., if the Forest Owner foregoes a desk-review verification). Monitoring reports must contain an update of the project's forest carbon inventory (Section 8.2). Each monitoring report must also contain the following additional information (note: Reforestation Projects, as qualified in Section 6.1, can defer the items that are marked with an asterisk until the second site-visit verification):

1. An updated estimate of the current year's carbon stocks in all required and optional carbon pools per the requirements of the inventory methodology approved at the time the project is registered, or with approved modifications.
2. *The appropriate confidence deduction for the forest carbon inventory, as determined at the last full site-visit verification for the project (following the guidance in Appendix A, Section A.4). The same confidence deduction must be used in interim years between verification site visits.
3. *An explanation for any decrease over any 10-year consecutive period in the standing live carbon pool.
4. Any changes in the status of the Forest Owner including, if applicable per Section 3.9.1, the acquisition of new forest landholdings.
5. A description of how the project meets (or will meet) the definition of "Natural Forest Management" (refer to Section 3.10.2), including progress on criteria that have not been fully met in previous years.
6. *An estimate of current-year harvest volumes and associated carbon in harvested wood products.
7. *Estimated mill efficiency, as determined following the guidance in Appendix C, Section C.2.
8. The baseline carbon stock estimates for all required and optional carbon pools for the current year, as determined following the requirements in Section 6 and approved at the time of the project's registration.
9. An estimate of Secondary Effects, following calculation steps and/or factors provided in Section 6 and approved at the time of the project's registration.
10. The uncertainty discount for Avoided Conversion Projects, as determined following the requirements of Section 6.3 and approved at project registration. (Once a project is registered with the Reserve, the uncertainty discount does not change.)
11. A preliminary calculation of total net GHG reductions and removals (or reversals) for the year, following the requirements in Section 6.
12. If a reversal has occurred during the previous year, the report must provide a written description and explanation of the reversal, whether the Reserve classified the reversal as Avoidable or Unavoidable, and the status of compensation for the reversal.
13. *The project's reversal risk rating, as determined following the requirements in Section 7 and Appendix D. The risk rating is updated during each full site-verification. Between verification site visits, the project's reversal risk rating does not change.
14. *A preliminary calculation of the project's Buffer Pool contribution.

9.3 Reporting and Verification Cycle

Forest Owners must have project data verified with a site visit by an approved third-party verification body at least once every six years (Section 9.3.2.1). In between site-visit verifications, Forest Owners may choose to have monitoring data verified through desk review verification (Section 9.3.2.2). Upon completion of a reporting period, if the Forest Owner chooses to defer verification, the Forest Owner must provide the monitoring report for the reporting period to the Reserve.

A Forest Project is considered automatically terminated (see Section 3.4) if the Forest Owner chooses not to report data and undergo verification at required intervals.

9.3.1 Reporting Period Duration and Cycle

A "reporting period" is a period of time for which a Forest Owner quantifies and reports GHG reductions and removals (i.e. the length of time covered by a monitoring report). Reporting periods for Forest Projects have a required duration of 12 months, with two exceptions:

1. A Forest Project's first reporting period (i.e. the reporting period that precedes initial verification) may be any length of time, lasting from the project's start date to any date prior to the initial verification.
2. A Forest Project's second reporting period may be less than 12 months, but no greater than 12 months.

All reporting periods after the second reporting period must be 12 months in duration, and cover the same calendar period each year. Reporting periods must be contiguous, i.e., there must be no gaps in reporting during the crediting period of a Forest Project once the first reporting period has commenced.

9.3.2 Verification Cycle

All Forest Projects must be initially verified within 30 months of being submitted to the Reserve. For any required and optional verifications thereafter, projects must be verified within 6 months of the end of the reporting period being verified. Up to 60 months of GHG reductions or removals may be verified through a single verification, which may cover multiple reporting periods. The period of time over which GHG reductions/removals are verified is referred to as the "verification period." The end date of any verification period must correspond to the end date of a reporting period.

9.3.2.1 Minimum Required Site-Visit Verification Schedule

Except as allowed for the second verification of Reforestation Projects, the Reserve requires that an approved third-party verification body review and assess all reported data and information for a Forest Project and conduct a site visit at least once every six years. Site-visit verifications are also required anytime the Forest Owner would like to establish new confidence deductions and/or reversal risk ratings.

For Reforestation Projects, the second verification may be deferred beyond six years at the discretion of the Forest Owner. If deferred, the second verification must be a site-visit verification.

9.3.2.2 Optional Desk Review Verification

In between site-visit verifications, the Forest Owner may choose to have an approved third-party verification body conduct a desk review of annual monitoring reports. CRTs may be issued for GHG reductions/removals verified through such desk reviews.

Submission of annual monitoring reports to the Reserve is required even if the Forest Owner chooses to forego desk review verification.

Desk reviews verifications are not permitted for Reforestation Projects between the initial and second site-visit verifications if the Forest Owner has opted to defer the second verification.

9.3.3 Issuance and Vintage of CRTs

The Reserve will issue Climate Reserve Tonnes (CRTs) for quantified GHG reductions and removals that have been verified through either site visits or desk reviews. A site-visit

verification may determine that earlier desk reviews overestimated onsite carbon stocks. Any resulting downward adjustment to carbon stock estimates will be treated as a reversal (see Section 7.1). In this case, the Forest Owner must retire CRTs in accordance with the requirements for compensating for a reversal (Section 7.3).

Reforestation Projects for which an initial inventory is deferred are not eligible to receive CRTs until after the second site-visit verification.

In general, vintages will be assigned to CRTs by *reporting* period according to the proportion of each reporting period that falls within a particular calendar year. For example, suppose a Forest Project's second reporting period spans five months, from November 1, 2010 to April 1, 2011, and its third reporting period spans the entire 12 months between April 1, 2011 and April 1, 2012. The project undergoes verification for the entire 17-month period (i.e. the verification period covers two reporting periods, from November 1, 2012 to April 1, 2014). One hundred CO_2-equivalent tonnes of GHG reductions/removals are verified for the second reporting period and 500 tonnes are verified for the third reporting period. In this case, 40 CRTs would be issued and assigned a 2010 vintage (61 days out of 151 days applied to 100 tonnes for the second reporting period); 436 CRTs would be issued and assigned a 2011 vintage (90 days out of 151 days applied to 100 tonnes for the second reporting period, plus 275 days out of 366 days applied to 500 tonnes for the third reporting period); and 64 CRTs would be issued and assigned a 2012 vintage (91 days out of 366 days applied to 500 tonnes for the third reporting period).

For a Forest Project's first reporting period only, if the reporting period covers more than two years, CRTs will be assigned a vintage according to the timing of GHG reductions/removals as determined through past inventories and modeling of changes in carbon stocks over the reporting period. If the first reporting period is two years or less, then issued CRTs will be assigned vintages according to the proportion of the reporting period that falls within each calendar year.

9.4 Record Keeping

For purposes of independent verification and historical documentation, project developers are required to keep all documents and forms related to the project for a minimum of 100 years after the final issuance of CRTs from the Reserve. This information may be requested by the verification body or the Reserve at any time.

9.5 Transparency

The Reserve requires data transparency for all Forest Projects, including data that displays current carbon stocks, reversals, and verified GHG reductions and removals. For this reason, all non-confidential project data reported to the Reserve will be publicly available on the Reserve's website.

10 Verification Guidance

This section provides guidance to Reserve-approved verification bodies for verifying GHG emission reductions associated with a planned set of activities to remove, reduce or prevent CO_2 emissions in the atmosphere by conserving and/or increasing forest carbon stocks.

This section supplements the Reserve's Verification Program Manual found on the Reserve website at http://www.climateactionreserve.org/how/program/program-manual/. The Verification Program Manual provides verification bodies with the general requirements for a standardized approach for independent and rigorous verification of GHG emission reductions and removals, the verification process, the requirements for conducting verification, conflict of interest and confidentiality provisions, the core verification activities, content of the verification report, and dispute resolution processes. In addition, the Verification Program Manual explains the basic verification principles of ISO 14064-3:2006 which must be adhered to by the verification body.

Forest Project verification bodies must read and be familiar with the following International Organization for Standardization (ISO) and Reserve documents and reporting tools:

1. Forest Project Protocol (this document)
2. Reserve Verification Program Manual
3. Reserve software
4. ISO 14064-3:2006 Principles and Requirements for Verifying GHG Inventories and Projects

Only Reserve-approved Forest Project verification bodies are eligible to verify Forest Project reports. Approved verification bodies under the California Climate Action Registry's General Verification Protocol are not automatically permitted to verify Forest Project reports. To become a recognized Forest Project verifier, verification bodies must become accredited under ISO 14065. Information on the accreditation process can be found on the Reserve website at http://www.climateactionreserve.org/how/verification/how-to-become-a-verifier/.

10.1 Standard of Verification

The Reserve's standard of verification for Forest Projects is the Forest Project Protocol (FPP), the Reserve Program Manual, and the Reserve Verification Program Manual. To verify a land owner's initial Forest Project Design Document and annual monitoring reports, verification bodies apply the verification guidance in the Reserve's Verification Program Manual and this section of the FPP to the requirements and guidance described in Sections 2 through 9 of the FPP.

This section of the FPP provides requirements and guidance for the verification of projects associated with the three Forest Project types defined in Section 2 of the FPP, i.e., Reforestation Projects, Improved Forest Management Projects, and Avoided Conversion Projects. All three project types involve planned activities that result in conserving and/or increasing forest carbon stocks. This section describes the core verification activities and criteria for each of the three Forest Project types that are necessary for a verification body to provide a reasonable level of assurance that the GHG removals or reductions quantified and reported by Forest Owners are materially correct.

Verification bodies will use the criteria in this section to determine if there exists reasonable assurance that the data submitted on behalf of the Forest Owner to the Reserve addresses

each requirement in the FPP, Sections 2 through 9. Project reporting is deemed accurate and correct if the Forest Owner is in compliance with the Section 2 through 9 of the FPP.

Further information about the Reserve's principles of verification, levels of assurance, and materiality thresholds can be found in the Reserve's Verification Program Manual at http://www.climateactionreserve.org/how/program/program-manual/.

10.2 Emission Sources, Sinks, and Reservoirs

For all verification activities, verification bodies review a project's reported sources, sinks, and reservoirs to ensure that all are identified properly and to confirm their completeness. Tables 5.1, Table 5.2, and Table 5.3 in Section 5 provide comprehensive lists of all GHG sources, sinks, and reservoirs that must be included in the quantification and reporting of GHG reductions and removals for the three Forest Project types.

It is the Forest Owner's responsibility to ensure that verifications are conducted according to the minimum required schedule specified in Section 9.3.2. A Verification Report, List of Findings, and Verification Opinion must be submitted within 6 months of the end of any verification period. Site-visit verification requirements are described in Section 10.3.2. Desk review verification requirements are described in Section 10.3.3.

10.3 Project Verification Activities

Required verification activities for Forest Projects will depend on whether the verification body is conducting an initial verification for registration on the Reserve, a minimum required verification involving a site visit, or an optional annual verification involving a desk review. Both the initial verification and ongoing verifications must include review of the criteria for Natural Forest Management, inventory of onsite carbon stocks, assessment of carbon in harvested wood products, and review of reversal risk ratings. The following sections contain guidance for all of these verification activities.

10.3.1 Initial Verification

Initial verification includes verification that the Forest Project has met the FPP criteria and requirements for eligibility, project area definition, modeling baseline onsite carbon stocks, and calculating baseline carbon in harvested wood products. The initial verification must include a site visit. The verification body must assess and ensure the completeness and accuracy of all of required reporting elements for the Forest Project Design Document (Section 9.1.1). Initial verification items are presented in tables 10.1A through 10.1L. *At a Forest Project's initial verification, these items must be verified in addition to all the items required for a standard site-visit verification, as detailed in Section 10.3.2.*

10.3.1.1 Initial Eligibility

Verification bodies are required to affirm the project's eligibility according to the rules in this protocol. Tables 10.1A, 10.1B, and 10.1C provide the initial verification items concerning eligibility for the three different Forest Project types and include references to sections of this protocol where requirements are further specified.

Table 10.1A. Initial Eligibility Verification Items – Reforestation Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Project Definition	1.a Evidence exists of canopy cover < 10% for 10 years, or 1.b Evidence of significant disturbance provided. 1.c Project has demonstrated no consideration of commercial activities. 1.d No evidence exists for use of broadcast fertilization.	2.1.1	Yes
2. Legal Requirement Test	2. Proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve.	3.1.1.1	No
3. Performance Test	3.a Reforestation Project that meets 1.a, or 3.b Meets 1.b and shows that the Forest Project corresponds to an "eligible" scenario in Appendix E, or 3.c Shows that the project occurs on a type of land for which the Forest Owner has not historically engaged in or allowed timber harvesting.	3.1.2.1, Appendix E	Yes (for 3.c)
4. Start Date	4. Identification of the date on which tree planting occurred or will occur, site preparation for the planting of trees occurred or will occur, or removal of impediments to natural regeneration occurred or will occur (whichever was or will occur first).	3.2	No
5. Project Implementation Agreement	5. Proof that a Project Implementation Agreement (PIA) between the Forest Owner and the Reserve has been signed and recorded in the county of interest.	3.5	No
6. Project Location	6.a Project is located in the United States of America 6.b Project is on private land, or 6.c If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or 6.d If Tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities.	3.8	No

Table 10.1B. Initial Eligibility Verification Items – Improved Forest Management Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Project Definition	1.a Evidence is provided indicating the canopy cover exceeds 10%. 1.b No evidence exists for use of broadcast fertilization.	2.1.2	Yes (for 1.b)
2. Start Date	2. Identification of a discrete, verifiable action that delineates a change in practice relative to the project's baseline.	3.2	No
3. Project Implementation Agreement	3. Proof that a Project Implementation Agreement (PIA) between the Forest Owner and the Reserve has been signed and recorded in the county of interest.	3.5	No
4. Project Location	4.a Project is located in the United States of America. 4.b Project is on private land, or 4.c If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or 4.d If Tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities.	3.8	No

Table 10.1C. Initial Eligibility Verification Items – Avoided Conversion Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Project Definition	1.a Proof that the project is/was on private land prior to project initiation. 1.b Proof that a qualified conservation easement was recorded, or the land was transferred to public ownership. 1.c Demonstration that conversion out of forest is a significant risk (following the requirements of Section 6.3.1 – see also Table 10.1H). 1.d No evidence exists for use of broadcast fertilization.	2.1.3, 6.3.1	Yes (for 1.c and 1.d)

2. Legal Requirement Test	2.a Proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve. 2.b Documentation has been provided that demonstrates that the type of land use conversion anticipated by the project is legally permissible; documentation must fall into at least one of the three categories specified in Section 3.1.1.3.	3.1.1.3	No
3. Performance Test	3. Copy of real estate appraisal for the Project Area indicating conformance to criteria in Section 3.1.2.3.	3.1.2.3	No
4. Start Date	4. Identification of date on which a qualified conservation easement was recorded or the Project Area was transferred to public ownership.	3.2, 3.6	No
5. Project Implementation Agreement	5. Proof that a Project Implementation Agreement (PIA) between the Forest Owner and the Reserve has been signed and recorded in the county of interest.	3.5	No
6. Project Location	6.a Project is located in the United States of America. 6.b Project is on private land, or 6.c If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or 6.d If Tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities.	3.8	No

10.3.1.2 Project Area Definition

Verification bodies are required to review the geographic boundaries defining the Project Area and their compliance with the requirements outlined in Section 4 of this protocol.. These items are verified only at the project's initiation.

Table 10.1D. Project Area Definition Verification Items

Project Type	Verification Items	Section of FPP	Apply Professional Judgment?
1. All	1. Proof that a description and maps of the geographic boundaries defining the Project Area are on file at the Reserve.	4, Appendix A	No
2. Avoided Conversion	2. Project Area has been defined following the guidance in Section 4, Table 4.1 for the appropriate conversion type.	4	No

10.3.1.3 Modeling Baseline Onsite Carbon Stocks

Verification bodies are required to confirm that the Forest Owner has developed a baseline characterization for onsite carbon stocks according to the requirements in this protocol. These items are verified only at the project's initiation.

Table 10.1E. Baseline Modeling Verification Items – Reforestation Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Qualitative Characterization	1. Clear qualitative characterization of vegetative conditions and activities that would have occurred without the project	6.1.1	Yes
2. Inventory of Onsite Carbon Stocks	2.a An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and guidance in Appendix A (see Section 10.3.5 for further verification guidance). 2.b The inventory of carbon stocks has been deferred until the second site visit verification.	6.1.1, Appendix A	Yes
3. Baseline Carbon Stock Modeling	3.a A computer simulation has been conducted that models the carbon stocks in accordance with the requirements and guidance in Section 6.1.1 and Appendix B (see Section 10.3.6 for further verification guidance), or 3.b The computer simulation has been deferred until the project's second site visit verification.	6, 6.1.1, Appendix B	Yes
4. Description of Forest Project Activities	4. A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline.	9.1.1	No

Table 10.1F. Baseline Modeling Verification Items – Improved Forest Management Projects - Private Lands

Verification Items		Section of FPP	Apply Professional Judgment?
1. Inventory of Onsite Carbon Stocks	1. An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and guidance in Appendix A (see Section 10.3.5 for further verification guidance)..	6.2.1, Appendix A	Yes
2. Compare Initial Above-Ground Standing Live Carbon Stocks with Common Practice	2.a The baseline analysis utilizes the correct value for Common Practice (for above-ground standing live carbon stocks) associated with the Assessment Area(s) covered the Project Area. 2.b Initial above-ground standing live carbon stocks have been estimated correctly following the requirements and guidance in Appendix A.	6.2.1, Appendix F 6.2.1, Appendix A	No

3. Baseline Carbon Stock Modeling	3. A 100-year forest management simulation of standing live carbon stocks has been conducted in accordance with the requirements and guidance in Section 6.2.1 and Appendix B (see Section 10.3.6 for further verification guidance).	6.2.1, Appendix B	Yes
4. Description of Forest Project Activities	4. A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline.	9.1.1	No

Table 10.1G. Baseline Modeling Verification Items – Improved Forest Management Projects – Public Lands

Verification Items		Section of FPP	Apply Professional Judgment?
1. Initial Forest Carbon Stock Inventory	1. An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and guidance in Appendix A (see Section 10.3.5 for further verification guidance).	6.2.2, Appendix A	Yes
2. Baseline Carbon Stock Modeling	2. A 100-year forest management simulation of standing live carbon stocks has been conducted per the requirements in Section 6.2.2 and Appendix B (see Section 10.3.6 for further verification guidance).	6.2.2, Appendix B	Yes
3. Description of Forest Project Activities	3. 4. A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline.	9.1.1	No

Table 10.1H. Baseline Modeling Verification Items – Avoided Conversion Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Initial Forest Carbon Stock Inventory	1. An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and guidance in Appendix A (see Section 10.3.5 for further verification guidance).	6.3.1, Appendix A	Yes
2. Baseline Carbon Stock Modeling	2.a An alternative highest-value land use for the Project Area has been clearly identified by the required appraisal. 2.b The rate of conversion and removal of onsite forest carbon stocks has been appropriately estimated in accordance with the requirements of Section 6.3.1, Step 1. 2.c A 100-year forest management simulation of standing live carbon stocks has been conducted per the requirements in Section 6.3.1, Step 1 and Appendix B (see Section 10.3.6 for further	3.1.2.3, 6.3.1	Yes

	verification guidance).		
3. Discount for the Uncertainty of Conversion Probability	3. The Avoided Conversion Discount factor has been correctly calculated per Equation 6.6 in Section 6.3.1, Step 2.	3.1.2.3, 6.3.1	No
4. Description of Forest Project Activities	4. A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline.	9.1.1	No

10.3.1.4 Calculating Baseline Carbon in Harvested Wood Products

Verification bodies are required to confirm that the Forest Owner has developed a baseline characterization for carbon in harvested wood products according to the requirements of this protocol.

Table 10.1I. Baseline Carbon in Wood Products Verification Items – Reforestation Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Baseline Harvest Volume	1. If harvesting of any pre-existing trees would be expected to occur in the baseline, the *average* volume of harvesting in each year of the baseline over 100 years has been determined per the requirements and guidance in Section 6.1.2, Appendix B, and Appendix C (see Section 10.3.7 for further verification guidance)..	6.1.2, Appendix B, Appendix C	No
2. Long-Term Storage in Wood Products	2. The average amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and guidance of Section 6.1.2 and Appendix C (see Section 10.3.7 for further verification guidance).	6.1.2, Appendix C	No

Table 10.1J. Baseline Carbon in Wood Products Verification Items – Improved Forest Management Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Baseline Harvest Volume	1. The *average* volume of harvesting in each year of the baseline over 100 years has been derived from the growth and harvesting regime used to develop the baseline for onsite carbon stocks, following the requirements and guidance in Section 6.2.1 or 6.2.2, Section 6.2.3, Appendix B, and Appendix C (see Section 10.3.7 for further verification guidance).	6.2.1, 6.2.2, 6.2.3, Appendix B, Appendix C	No
2. Long-Term Storage in Wood Products	2. The average amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and guidance of Section 6.2.3 and Appendix C (see Section 10.3.7 for further verification guidance).	6.2.3, Appendix C	No

Table 10.1K. Baseline Carbon in Wood Products Verification Items – Avoided Conversion Projects

Verification Items		Section of FPP	Apply Professional Judgment?
1. Baseline Harvest Volume	1. The volume of harvesting in each year of the baseline over 100 years has been derived from the harvesting regime assumed for the baseline for onsite carbon stocks, following the requirements and guidance in Section 6.3.2, Appendix B, and Appendix C (see Section 10.3.7 for further verification guidance).	6.3.1, 6.3.2, Appendix B, Appendix C,	No
2. Long-Term Storage in Wood Products	2. The amount of harvested wood that would be delivered to mills in each year has been determined, and the amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and guidance of Section 6.3.2 and Appendix C (see Section 10.3.7 for further verification guidance).	6.3.2, Appendix C	No

10.3.2 Site-Visit Verification

Site-visit verification involves review of the Forest Project's carbon stock inventory estimates, relevant attestations, risk of reversal ratings, and compliance with Natural Forest Management criteria. After a Forest Project's initial verification, subsequent site visits must assess and ensure accuracy in measurement and monitoring techniques and onsite record keeping practices.

Table 10.2. Site Visit Verification Items

Verification Items		Section of FPP	Apply Professional Judgment?
1. Legal Requirement	1. *For Improved Forests Management projects only*, proof that a signed Attestation of Voluntary	3.1.1.2	No

Test (IFM Projects Only)*	Implementation form is on file with the Reserve for the reporting period.		
2. Attestation of Title	2. Proof that a signed Attestation of Title is on file at the Reserve for the dates of the verification period. In addition to reviewing this form, the verification body must conduct a review to confirm ownership and claims to GHG reductions/removals that have occurred over the verification period.	3.7	Yes
3. Regulatory Compliance	3. Proof that a signed Attestation of Regulatory Compliance form is on file with the Reserve for the reporting period. In addition to reviewing this form, the verification body must perform a risk-based assessment to confirm the statements made by the Forest Owner in the Attestation of Regulatory Compliance form.	3.9	Yes
4. Sustainable Harvesting Practices	4.a Commercial harvesting is neither planned nor ongoing within the Project Area, or 4.b At the time commercial harvesting is either planned or initiated within the Project Area, the Forest Owner meets sustainable harvest practices on all of its landholdings, as described in Section 3.10.1.	3.10.1	No
5. Change in Forest Owner Landholdings	5. If the Forest Owner has acquired additional forestlands outside of the Project Area, the Forest Owner must incorporate the newly acquired land in their demonstration of sustainable long-term harvesting practices within 5 years of the acquisition.	3.10.1	No
6. Maintenance of Standing Live Carbon Pool	6. No decrease has occurred in the Project Area's standing live carbon stocks over any ten-year consecutive period not accounted for by allowable exceptions	3.10.3	No
7. Natural Forest Management	7. Natural Forest Management eligibility criteria in Section 3.10.2 have been and continue to be met (see Section 10.3.4 for further verification guidance).	3.10.2	Yes
8. Estimates of Actual Onsite Carbon Stocks	8.a An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and guidance in Appendix A and Appendix B (see Section 10.3.5 for further verification guidance).or 8.b Inventory has been deferred until the second site-visit verification for Reforestation Projects.	6.1.3, 6.2.4, 6.3.3, Appendix A, Appendix B	Yes
9. Estimates of Actual Carbon in Harvested Wood Products	9. The amount of harvested wood that has been delivered to mills over the reporting period has been determined correctly, and the amount of carbon expected to be transferred to wood products and stored over the long-term (100 years) has been calculated correctly, per the requirements in Section 6 and the requirements and guidance in Appendix C (see Section 10.3.7 for further verification guidance).	6.1.4, 6.2.5, 6.3.4, Appendix C	No
10. Quantification of Primary Effect	10. Calculations for the Primary Effect are complete and accurate for both onsite carbon stocks and harvested wood products.	6	No

11. Quantification of Secondary Effects	11. Calculations for quantifying Secondary Effects are complete and accurate.	6.1.5, 6.2.6, 6.3.5	No
12. Reversal Determination	12. If a reversal has occurred, the type of reversal (avoidable or unavoidable) has been properly identified	7.3	Yes
13. Reversal Risk Rating	13. Project's risk rating has been calculated following the requirements of Appendix D (see Section 10.3.8 for further verification guidance).	Appendix D	No

* For Reforestation and Avoided Conversion projects, a signed Attestation of Voluntary Implementation is only required at the project's first verification, as a condition for registration (Tables 10.1A and 10.1C, above)..

10.3.3 Desk Review Verification

For reporting periods in between required site visits, project verification activities may consist of a desk review. During a desk review, the verification body will review the data in annual monitoring reports to check calculations and information for reasonability, accuracy, and completeness.

Table 10.3. Desk Review Verification Items

Verification Items		Section of FPP	Apply Professional Judgment?
1. Legal Requirement Test (IFM Projects Only)*	1. *For Improved Forests Management projects only*, proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve for the reporting period.	3.1.1.2	No
2. Attestation of Title	2. Proof that a signed Attestation of Title is on file at the Reserve for the dates of the verification period. In addition to reviewing this form, the verification body must conduct a review to confirm ownership and claims to GHG reductions/removals that have occurred over the verification period.	3.7	Yes
3. Regulatory Compliance	3. Proof that a signed Attestation of Regulatory Compliance form is on file with the Reserve for the reporting period. In addition to reviewing this form, the verification body must perform a risk-based assessment to confirm the statements made by the Forest Owner in the Attestation of Regulatory Compliance form.	3.9	Yes
4. Maintenance of Standing Live Carbon Pool	4. No decrease has occurred in the Project Area's standing live carbon stocks over any ten-year consecutive period not accounted for by allowable exceptions	3.10.3	No
5. Estimates of Actual Onsite Carbon Stocks	5. Reported onsite carbon stocks are within expected bounds given reported harvest, growth, and disturbance effects since the prior reporting period.	6.1.3, 6.2.4, 6.3.3, Appendix A, Appendix B	Yes

6. Estimates of Actual Carbon in Harvested Wood Products	6. The reported amount of wood that has been delivered to mills over the reporting period is consistent with reported harvest levels, and the amount of carbon expected to be transferred to wood products and stored over the long-term (100 years) has been calculated correctly, per the requirements in Section 6 and the requirements and guidance in Appendix C (see Section 10.3.7 for further verification guidance).	6.1.4, 6.2.5, 6.3.4, Appendix C	Yes
7. Quantification of Primary Effect	7. Calculations for the Primary Effect are complete and accurate for both onsite carbon stocks and harvested wood products.	6	No
8. Quantification of Secondary Effects	8. Calculations for quantifying Secondary Effects are complete and accurate.	6.1.5, 6.2.6, 6.3.5	No
9. Reversal Determination	9. If a reversal has occurred, the type of reversal (avoidable or unavoidable) has been properly identified	7.3	Yes
10. Reversal Risk Rating	10. Reversal risk rating is the same used since the previous site-visit verification.	Appendix D	No

10.3.4 Natural Forest Management

All Forest Projects must promote and maintain a diversity of native species and utilize management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple landscape scales (Natural Forest Management). At a Forest Project's first site-visit verification and at all subsequent site-visit verifications, the verification body must evaluate the project against the Natural Forest Management criteria described in Section 3.9.2, referencing the most current Assessment Area Data File available on the Forest Project Protocol Resources section of the Reserve's website. Forest project carbon stock inventories (requirements for which are contained in Appendix A) should be used as the basis of these assessments where applicable. Forest projects that do not initially meet Natural Forest Management criteria but can demonstrate progress towards meeting these criteria within the required timelines are eligible to register and maintain that registration with the Reserve.

Table 10.4. Natural Forest Management Verification Items

Verification Items		Apply Professional Judgment?
1. Native Species	1. Completed inventory demonstrates that project consists of at least 95% native species. Must demonstrate continuous progress toward goal and criterion must be met within 50 years.	Yes

2. Composition of Native Species	2.a Reforestation Projects: Documentation on planted mixture of species meets composition of native species goals. Project must show continuous progress and criteria must be met within 50 years. 2.b Improved Forest Management and Avoided Conversion Projects: Completed inventory demonstrates standing live carbon meets composition of native species goal. Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved over the project life.	Yes
3. Sustainability of Timber Resource	3.a Documentation showing that the forest, including entity lands outside Project Area, is currently under one of the following: i. Third party certification under the Forest Stewardship Council or Sustainable Forestry Initiative/ Tree Farm System, or ii. A renewable long-term management plan sanctioned and monitored by a state or federal agency, or iii. Uneven-aged silvicultural practices (if harvesting occurs) and canopy retention averaging at least 40 percent across the entire forestland owned by the Forest Owner in the same Assessment Areas covered by the Project Area, as measured on any 20 acres within the Forest Owner's landholdings found in any of these Assessment Areas, including land within and outside of the Project Area (areas impacted by Significant Disturbance may be excluded from this test). 3.b Completed inventory demonstrates the project maintains, or makes progress toward maintaining, no more than 40 percent of forested acres in ages less than 20 years. Project must show continuous progress and this criterion must be met within 25 years.	Yes
4. Structural Elements (Lying and Standing Dead Wood)	4. Completed inventory work demonstrates that lying and standing dead wood is retained in sufficient quantities and for sufficient duration depending on whether portions of the project area have undergone salvage harvesting.	Yes

10.3.5 Inventories of Onsite Carbon Stocks

Verification bodies are required to verify carbon stock inventory estimates of each required (and selected optional) carbon pool within the Project Area. Inventories of carbon stocks are used to determine the project baseline and to quantify GHG reductions and removals over time.

For Reforestation Projects, the inventory methodology and implementation of the inventory can be deferred – for carbon pools that are not affected by site preparation – until the project's second site-visit verification. For those carbon pools affected by site preparation, a 'good faith'

estimate (an estimate not required to meet the minimum confidence requirement) based on a minimum of 20 plots (installed by the Forest Owner) for the purposes of measuring the affected pool shall be used. The baseline estimate must be updated (corrected) with all required carbon pools at the time project's second site-visit verification.

All reports that reference carbon stocks must be submitted by the Forest Owner with the oversight of a Professional Forester. If the project is located in a jurisdiction without a Professional Forester law or regulation, then Certified Forester credentials managed by the Society of American Foresters (see http://www.certifiedforester.org) are required so that professional standards and project quality are maintained.

Verification of carbon stock inventories should focus on reviewing the inventory methodology and correct implementation of the methodology. The verification body should determine the level of intensity for verification review, which will determine the number and location of verification plots.

First, the verification body will review and determine if the Forest Owner has provided a strong or weak demonstration for the inventory methodology items in Table 10.5. For each item in Table 10.5, the verification body should assign a value of 1 for a strong demonstration and a value of 2 for a weak verification.

Table 10.5. Inventory Methodology Verification Items

Verification/Evaluation Items		Apply Professional Judgment?
1.a	Plot locations are established is such a way that the verification body can acquire independent data from within the measurement area and compare with Forest Owner inventory reports.	Yes
1.b	Inventory methodology document exists. Document is clear and Forest Owner can demonstrate implementation.	Yes
1.c	Forest vegetation is stratified (either before or after sampling) or Forest Owner can demonstrate a methodology that enables the verification body to compare inventory statistics to defined areas (polygons).	Yes
1.d	Updating process clearly defined in inventory methodology document and Forest Owner demonstrates adherence to methodology. Inventory, through update processes, is current.	Yes
1.e	Field observations or aerial photos/other remote sensing comparison to inventory reports demonstrate high correlation.	Yes

The level of verification review or intensity is based on the systematic (inherent in all projects) and individual project risk of inaccuracy in the inventory. Verification bodies should consult Table 10.6 to identify the appropriate intensity of review based on the size of the Project Area. Smaller Project Areas have a lower systematic risk than larger areas because, from a programmatic perspective, the consequences of inaccuracy are not as significant.

Table 10.6. Verification Intensity Multiplier

Smaller Forests have Lower Total Carbon/Lower Programmatic Risk

Larger Forests have Higher Total Carbon/Higher Programmatic Risk

Project Area Acres	Verification Intensity Multiplier
<2,500	0.5
2,500 - 4,999	1
5,000 - 7,499	1.5
7,500 - 9,999	2
10,000 - 12,499	2.5
12,500 - 14,999	3
15,000 - 17,499	3.5
17,500 - 19,999	4
20,000 - 22,499	4.5
22,500 - 24,499	6
>=25,000	6.5

The level of verification field review, or "Verification Field Intensity," is determined by multiplying the values assigned to each item in Table 10.5 with each other and with the verification intensity multiplier identified in Table 10.6. Table 10.7 provides an example of applying this method to determine the Verification Field Intensity for a Forest Owner with 6,000 acres with demonstrated criteria as stated in the table.

Table 10.7. Calculating the Verification Field Intensity for a Forest Owner with 6,000 Acres

Verification Multiplier	Item 1	Item 2	Item 3	Item 4	Item 5	Verification Field Intensity
(from Table 10.6)	(from Table 10.5)					
1.5	1	2	1	1	2	6

Once the Verification Field Intensity level has been calculated, field verification shall consist of the installation of a default set of plots equal to 4 times the Verification Field Intensity. In the example in Table 10.7, the verification body would install a total of (4 x 6) or 24 plots. A minimum of one set of 4 plots is required to perform the analysis.

The verification body shall allocate the verification plot sets according to the appropriate distribution corresponding to the Verification Field Intensity, as identified in Table 10.8. Each plot set is installed by the verification body, or a consultant hired by the verification body, for an identified area and compared to the Forest Owner's reported inventory for the same area. The comparison is analyzed using a paired T-test at the 80% confidence interval to determine if the inventory is within the same population as the inventory submitted by the Forest Owner.

Table 10.8. Allocation of Plot Sets

Verification Field Intensity	<3			3 – 10			>10		
Stocking Level within Project Area	Highest 33%	Middle 33%	Lowest 33%	Highest 33%	Middle 33%	Lowest 33%	Highest 33%	Middle 33%	Lowest 33%
Plot Set Allocation	100%	0%	0%	60%	40%	0%	60%	30%	10%

A plot set will either support or raise concerns about the accuracy of the Forest Owner's inventory. A Forest Owner receiving an 80% score or better has demonstrated that their inventory is sound. Forest Owners that do not meet this standard may choose to have additional plot sets analyzed and added to all previous plot sets, or determine that their inventory requires additional effort prior to pursuing further verification activities, with the understanding that the Forest Owner will bear the expense of additional effort. The verification body can also apply their discretion to add more plots in the event the Forest Owner does not meet the score.

Finally, in addition to evaluating and verifying adherence to the Forest Owner's inventory methodology, the verification body must verify the items in Table 10.9.

Table 10.9. Additional Verification Items for Inventory Methodology and Implementation

Verification Items		Apply Professional Judgment?
1. Other Verified Required and Optional Pools	1. Sampling methodologies for other reported pools adhere to the minimum required sampling criteria in Table A.2 of Appendix A, acceptable forestry practices, and have been implemented correctly.	Yes
2. Inventory Update Processes	2.a Forest Owner's Inventory Document describes methodology for updating inventory data resulting from growth, harvest, and disturbances, Methodology adheres to acceptable forestry practices.* 2.b Harvest/Disturbance updates in inventory management system are implemented per the specified methodology and are representative of the harvest or disturbance. 2.c Growth is accounted for using an approved growth model or using a stand table projection, as described in Appendix B.	Yes
3. Biomass Equations and Calculations	3.a The carbon tonnes per acre for a representative sample plot, computed using the Forest Owner's calculation tools, replicate output computed by the verification body.** 3.b All conversions and expansions are accurate.	Yes

*A forest biometrician employed by the state in which the project is located, or a consulting forest biometrician may be consulted in the event of a dispute between the verification body and Forest Owner. The written opinion of the forest biometrician, submitted to the Reserve as part of the verification report, shall be considered the authoritative word.

** The verification body must provide an (idealized) 'verification plot' consisting of all tree species in Project Area with varying heights and diameters existing within the project area. The plot need not correspond to an actual plot within the Project Area.

10.3.6 Baseline Modeling

To determine a Forest Project's baseline, computer models are used to project the Project Area's initial inventory of carbon stocks into the future under a set of constraints prescribed by this protocol (Section 6). Modeling must include assumptions about forest growth and harvest, as influenced by legal and financial constraints, and assumptions regarding the extent of harvest operations under business as usual conditions.

Verification bodies are required to verify the baseline estimate for the project at the initial site-visit verification for Improved Forest Management Projects and Avoided Conversion Projects. Reforestation baselines may be verified at the second site-visit verification.

Baseline modeling must incorporate initial inventory estimates and forecast how carbon stocks will change over the Forest Project's crediting period.

All reports that reference carbon stocks must be submitted by the Forest Owner with the oversight of a Professional Forester. If the project is located in a jurisdiction without a Professional Forester law or regulation, then Certified Forester credentials managed by the Society of American Foresters (see http://www.certifiedforester.org) are required so that professional standards and project quality are maintained.

Table 10.10. Baseline Modeling Verification Items

Verification Items		Section of FPP	Apply Professional Judgment?
1. Document	1. A modeling document exists that contains the all the verification items in this table.	9	No
2. Qualitative Characterization (Reforestation and Avoided Conversion only)	2. A sufficiently detailed qualitative characterization has been included in the modeling document that documents the general assumptions of the project's baseline. The qualitative assessment addresses the vegetative conditions and activities that would have occurred.	6.1, 6.3	Yes
3. Model Choice and Calibration	3.a The model used is an approved model. 3.b The Forest Owner has provided a rationale for any model calibrations or an sufficient explanation of why calibrations were not incorporated. 3.c The Forest Owner has provided a description of the site indexes used for each species and a sufficient explanation of the source of the site index values used.	Appendix B.1	Yes
4. Legal Constraints	4. A list of legal constraints is provided that includes an accurate description of the type and effect of each constraint on the ability to harvest	3.1.1, 6.1.1, 6.2.1.2,	Yes

	trees and the area constrained.	6.3.1	
5. Financial Constraints	5.a A sufficient qualitative description is provided indicating that the harvesting activity modeled in the baseline is a financially viable activity. 5.b For Improved Forest Management projects, Forest Owner has provided either a financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints; or has provided evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years.	3.1.2, 6.1.1, 6.2.1.3, 6.3.1, Appendix E	Yes
6. Silviculture Guidelines	6. The silviculture guidelines incorporated in the model demonstrate all legal constraints are applied in the model. The silviculture guidelines must include: i. A description of the trees retained by species groups ii. The level of retention iii. Harvest frequency iv. Regeneration assumptions	Appendix B	No
7. Modeling Guidelines	7.a Reforestation: Modeling is based on the qualitative characterization of the baseline and conducted per Section 6.1. 7.b Improved Forest Management: Modeling is conducted per Section 6.2. 7.c Avoided Conversion: Modeling is conducted per Section 6.3.	6.1, 6.2, 6.3	No
8. Modeling Outputs	8.a The Forest Owner has provided reports that display periodic harvest, inventory, and growth estimates for the entire project area presented as total carbon tonnes and carbon tonnes per acre. 8.b Estimates are within the range of expected growth patterns for the Project Area.	9, Appendix B	Yes

10.3.7 Verifying Estimates of Carbon in Harvested Wood Products

Verification bodies are required to verify the estimates of carbon that are likely to remain stored in wood products over a 100-year period, as submitted in the Forest Project Design Document (for baseline estimates) and annual monitoring reports (for actual wood product production). Accounting for wood product carbon must be applied only to actual or baseline volumes of wood harvested from within the Project Area. Trees harvested outside of the Project Area are not part of the Forest Project and must be excluded from any calculations.

Table 10.11. Carbon in Harvested Wood Products Verification Items

Verification Items	Section of FPP	Apply Professional Judgment?

1. Carbon in Harvested Wood Delivered to Mills	1.a Amount of wood harvested that will be delivered to mills has been estimated and reported. 1.b The appropriate wood density factor has been applied and/or water weight subtracted to result in pounds of biomass with zero moisture content. 1.c Total dry weights for all harvested wood have been calculated. 1.d Total carbon weight has been computed. 1.e The total has been converted to metric tonnes of carbon.	Appendix C.1	No
2. Account for Mill Efficiencies	2. The correct mill efficiency factors have been used to calculate total carbon transferred into wood products.	Appendix C.2	No
3. Wood Product Classification	3. The percentages of harvest by wood product class has been determined correctly with verified reports from the mill(s) where the Project Area's logs are sold; or by looking up default wood product classes for the project's Assessment Area(s); or if not available from either of these sources, by classifying all wood products as "miscellaneous."	Appendix C.3	No
4. Calculation of In-Use and Landfill Carbon Storage	4.a The average amount of carbon stored in in-use wood products over 100 years has been calculated correctly using the worksheets in Appendix C. 4.b The average amount of carbon stored in landfilled wood products over 100 years has been calculated correctly using the worksheets in Appendix C.	Appendix C.3, C.4	No
5. Total Average Carbon Storage in Wood Products Over 100 Years	5. Total average carbon storage in wood products over 100 years for a given harvest volume has been calculated and reported.	Appendix C.5	No

10.3.8 Verifying Calculations of Reversal Risk Ratings and Contributions to the Buffer Pool

At each site-visit verification, Forest Owners must derive a reversal risk rating for their Forest Project using the worksheets in Appendix D. The worksheets are designed to identify and quantify the specific types of risks that may lead to a reversal, based on project-specific factors.

Table 10.12. Reversal Risk Rating Verification Items

Verification Items		Section of FPP	Apply Professional Judgment?
1. Financial Risk	1. Use of a Qualified Conservation Easement or Qualified Deed Restriction, occurrence on public lands, or use of a PIA alone.	Appendix D.1	No

2. Management Risk	2.a Management Risk I – Illegal removals of forest biomass. 2.b Management Risk II – Conversion of project area to alternative land uses. 2.c Management Risk III – Over-harvesting.	Appendix D.2	No
3. Social Risk	3. Social Risk.	Appendix D.3	No
4. Natural Disturbance Risk	4.a Natural Disturbance Risk I – Wildfire 4.b Natural Disturbance Risk II – Disease or insect outbreak. 4.c Natural Disturbance Risk III – Other episodic catastrophic events.	Appendix D.4	Yes
5. Completing the Risk Rating Analysis	5. Reversal risk rating calculated correctly using the formula in Appendix D.5.	Appendix D.5	No

10.4 Completing the Verification Process

After completing the core project verification activities for a Forest Project, the verification body must do the following to complete the verification process:

1. Complete a Verification Report to be delivered to the Forest Owner (public document).
2. Complete a detailed List of Findings containing both immaterial and material findings (if any), and deliver it to the Forest Owner (private document).
3. Prepare a concise Verification Opinion detailing the vintage and the number of GHG reductions and removals verified, and deliver it to the Forest Owner (public document).
4. Verify that the number of GHG reductions and removals, as well as the reversal risk rating, specified in the Verification Report and Opinion match the number entered into the Reserve software.
5. Conduct an exit meeting with the Forest Owner to discuss the Verification Report, List of Findings, and Verification Opinion and determine if material misstatements (if any) can be corrected. If so, the verification body and Forest Owner should schedule a second set of verification activities after the Forest Owner has revised the project submission.
6. If a reasonable level of assurance opinion is successfully obtained, upload electronic copies of the Verification Report, List of Findings, Verification Opinion, and Verification Activity Log into the Reserve.
7. Return important records and documents to the Forest Owner for retention.

The recommended content for the Verification Report, List of Findings and Verification Opinion can be found in the Reserve's Verification Program Manual on the Reserve website at http://www.climateactionreserve.org/how/program/program-manual/. The Verification Program Manual also provides further guidance on quality assurance, negative verification opinions, use of an optional Project Verification Activity Log, goals for exit meetings, dispute resolution, and record keeping.

11 Glossary of Terms

Above-Ground Live Biomass	Live trees including the stem, branches, and leaves or needles, brush and other woody live plants above ground.
Activity-Based Funding	The budget line items that are dedicated to agency accomplishments in vegetation management, including pre-commercial thinning, commercial thinning, harvest, hazard tree removal, hazardous fuel reductions, and other management activities designed to achieve forest sustainability health objectives.
Additionality	A criterion for Forest Project eligibility. A Forest Project is "additional" if it would not have been implemented without incentives provided by the carbon offset market, including the incentives created through the Climate Action Reserve program. Under this protocol, Forest Projects meet the additionality criterion by demonstrating that they pass a legal requirement test and a performance test, as described in Section 3.1, and by achieving GHG reductions and removals quantified against an approved baseline, determined according to the requirements in Section 6.
Allometric Equation	An equation that utilizes the genotypical relationship among tree components to estimate characteristics of one tree component from another. Allometric equations allow the below ground root volume to be estimated using the above-ground bole volume.
Assessment Area	A distinct forest community within geographically identified ecoregions defined by the Reserve that consists of common regulatory and political boundaries that affect forest management. The size of the Assessment Areas is determined by efforts to achieve optimal statistical confidence across multiple scales using U.S. Forest Service Forest Inventory and Analysis Program (FIA) plots for biomass. Maps of the Assessment Areas and the associated data may be found on the Reserve's website.
Avoidable Reversal	An avoidable reversal is any reversal that is due to the Forest Owner's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the Project Area
Avoided Conversion Project	A type of Forest Project consisting of specific actions that prevent the conversion of forestland

	to a non-forest land use by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership.
Baseline	The level of GHG emissions, removals, and/or carbon stocks at sources, sinks, or reservoirs affected by a Forest Project that would have occurred under a Business As Usual scenario. For the purposes of this protocol, a project's baseline must be estimated following standard procedures in Section 6.
Best Management Practices	Management practices determined by a state or designated planning agency to be the most effective and practicable means (including technological, economic, and institutional considerations) of controlling point and nonpoint source pollutants at levels compatible with environmental quality goals.[13]
Biological Emissions	For the purposes of the Forest Project Protocol, biological emissions are GHG emissions that are released directly from forest biomass, both live and dead, including forest soils. For Forest Projects, biological emissions are deemed to occur when the reported tonnage of onsite carbon stocks, relative to baseline levels, declines from one year to the next.
Biomass	The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass.[14]
Bole	A trunk or main stem of a tree.
Broadcast Fertilization	A fertilizer application technique where fertilizer is spread across the soil surface.
Buffer Pool	The buffer pool is a holding account for Forest Project CRTs administered by the Reserve. It is used as a general insurance mechanism against unavoidable reversals for all Forest Projects registered with the Reserve. If a Forest Project experiences an unavoidable reversal of GHG reductions and removals (as defined in Section 7.3), the Reserve will retire a number of CRTs from the buffer pool equal to the total amount of carbon that was reversed (measured in metric tons of CO_2-equivalent).
Business As Usual	The activities, and associated GHG reductions and removals that would have occurred in the

[13] (Helms, 1998)
[14] (Metz, Davidson, Swart, & Pan, 2001)

	Project Area in the absence of incentives provided by a carbon offset market. Methodologies for determining these activities – and/or for approximating carbon stock levels that would have resulted from these activities – are provided in Section 6 of this protocol for each type of Forest Project.
Carbon Pool	A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include above-ground or below-ground biomass or harvested wood products, among others.
Climate Reserve Tonne	The unit of offset credits used by the Climate Action Reserve. Each Climate Reserve Tonne represents one metric ton (2204.6 lbs) of CO_2 reduced or removed from the atmosphere.
Common Practice	The average stocks of the live standing carbon pool from within the Forest Project's Assessment Area, derived from FIA plots on all private lands within the defined Assessment Area.
Even-Aged Management	Management where the trees in individual forest stands have only small differences in their ages (a single age class). By convention, the spread of ages does not differ by more than 20% of the intended rotation.
FIA	USDA Forest Service Forest Inventory and Analysis program. FIA is managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems. FIA has been in operation under various names (Forest Survey, Forest Inventory and Analysis) for 70 years.
Forest Management	The commercial or noncommercial growing and harvesting of forests.
Forest Owner	A Forest Owner is a corporation or other legally constituted entity, city, county, state agency, individual(s), or a combination thereof, that executes the Project Implementation Agreement, as described in Section 2.2 of this Forest Protocol.
Forest Project	A planned set of activities designed to increase removals of CO_2 from the atmosphere, or reduce or prevent emissions of CO_2 to the atmosphere, through increasing and/or conserving forest carbon stocks.

Forest Project Design Document	A standard document for reporting required information about a Forest Project. The Forest Project Design Document must be submitted for review by a verification body and approved by the Reserve before the Forest Project can be registered with the Reserve.
Forestland	Land that supports, or can support, at least 10 percent tree canopy cover and that allows for management of one or more forest resources, including timber, fish and wildlife, biodiversity, water quality, recreation, aesthetics, and other public benefits.
GHG Assessment Boundary	The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs that must be accounted for in quantifying a Forest Project's GHG reductions and removals (Section 6). The GHG Assessment Boundary encompasses all the GHG sources, sinks, and reservoirs that may be significantly affected by Forest Project activities, including forest carbon stocks, sources of biological CO_2 emissions, and mobile combustion GHG emissions.
GHG Reductions and Removals	See definitions for Reduction and Removal.
Greenhouse Gases (GHG)	Gases that contribute to global warming and climate change. For the purposes of this Forest Project Protocol, GHGs are the six gases identified in the Kyoto Protocol: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
Improved Forest Management Project	A type of Forest Project involving management activities that increase carbon stocks on forested land relative to baseline levels of carbon stocks.
Listed	A Forest Project is considered "listed" when the Forest Owner has created an account with the Reserve, submitted the required Project Submittal form and other required documents, paid the project submission fee, and the Reserve has approved and accepted the project for listing.
Litter	Any piece(s) of dead woody material from a tree, e.g. dead boles, limbs, and large root masses, on the ground in forest stands that is smaller than material identified as lying dead wood.
Lying Dead Wood	Any piece(s) of dead woody material from a tree, e.g. dead boles, limbs, and large root masses, on the ground in forest stands. Lying dead wood is all dead tree material with a minimum average

	diameter of 5" and a minimum length of 8'. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood.
Metric ton (MT) or "tonne"	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1 short tons.
Native Forest	For the purposes of this protocol native forests shall be defined as those occurring naturally in an area, as neither a direct nor indirect consequence of human activity post-dating European settlement.
Natural Forest Management	Forest management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple landscape scales. The application of this definition, its principles, detailed definition, and implementation are discussed further in Section 3.10.2.
Non-Forest Cover	Land with a tree canopy cover of less than 10 percent.
Non-Forest Land Use	An area managed for residential, commercial, or agricultural uses other than for the production of timber and other forest products, or for the maintenance of woody vegetation for such indirect benefits as protection of catchment areas, wildlife habitat, or recreation.
Non-Harvest Disturbance	Reduction in forest cover that is not a direct result of harvest, such as wildfire and insect disturbances.
Onsite Carbon Stocks	Carbon stocks in living biomass, dead biomass, and soils within the Project Area (see Table A.1).
Permanence	The requirement that GHGs must be permanently reduced or removed from the atmosphere to be credited as carbon offsets. For Forest Projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.
Primary Effects	The Forest Project's intended changes in carbon stocks, GHG emissions or removals.
Professional Forester	A professional engaged in the science and profession of forestry. A professional forester is credentialed in jurisdictions that have professional forester licensing laws and regulations. Where a jurisdiction does not have a

	professional forester law or regulation then a professional forester is defined as having the Certified Forester credentials managed by the Society of American Foresters (see www.certifiedforester.org).
Project Area	The area inscribed by the geographic boundaries of a Forest Project, as defined following the requirements in Section 4 of this protocol. Also, the property associated with this area.
Project Life	Refers to the duration of a Forest Project and its associated monitoring and verification activities, as defined in Section 3.4.
Public Lands	Lands that are owned by a public governmental body such as a municipality, county, state or country.
Qualified Conservation Easement	A qualified conservation easement must explicitly refer to the terms and conditions of the Project Implementation Agreement, apply to current and all subsequent Forest Owners for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol.
Qualified Deed Restriction	A qualified deed restriction shall ensure that the Project Implementation Agreement runs with the land and applies to all current and subsequent Forest Owners for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol, to be determined in the Reserve's reasonable discretion. A deed restriction is not "qualified" if it merely consists of a recording of the Project Implementation Agreement or a notice of the Project Implementation Agreement, as such a recording is already required by the Project Implementation Agreement.
Reduction	The avoidance or prevention of an emission of CO_2 (or other GHG). Reductions are calculated as gains in carbon stocks over time relative to a Forest Project's baseline (also see Removal).
Reforestation Project	A type of Forest Project involving the restoration of tree cover on land that currently has no, or minimal, tree cover.
Registered	A Forest Project becomes registered with the Reserve when it has been verified by a Reserve-approved and ISO-accredited verification body, all required documentation (see Section 9) has been submitted by the Forest Owner to the Reserve for final approval, and the Reserve

	approves the project.
Removal	Sequestration ("removal") of CO_2 from the atmosphere caused by a Forest Project. Removals are calculated as gains in carbon stocks over time relative to a Forest Project's baseline (also see Reduction).
Reporting Period	The period of time over which a Forest Owner quantifies and reports GHG reductions and removals. Reporting periods for Forest Projects generally have a required duration of 12 months, with two exceptions: 1. A Forest Project's first reporting period (i.e., the reporting period that precedes initial verification) may be any length of time, lasting from the project's start date to any date prior to the initial verification. 2. A Forest Project's second reporting period may be less than 12 months, but no greater than 12 months.
Reservoir	Physical unit or component of the biosphere, geosphere or hydrosphere with the capacity to store or accumulate carbon removed from the atmosphere by a sink, or captured from a source.
Retire	To retire a CRT means to transfer it to a retirement account in the Climate Action Reserve's software system. Retirement accounts are permanent and locked, so that a retired CRT cannot be transferred or retired again.
Reversal	A reversal is a decrease in the stored carbon stocks associated with quantified GHG reductions and removals that occurs before the end of the Project Life. Under this protocol, a reversal is deemed to have occurred if there is a decrease in the difference between project and baseline onsite carbon stocks from one year to the next, regardless of the cause of this decrease (i.e. if the result of ($\Delta AC_{onsite} - \Delta BC_{onsite}$) in Equation 6.1 is negative).
Secondary Effects	Unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the Forest Project.
Sequestration	The process of increasing the carbon (or other GHGs) stored in a reservoir. Biological approaches to sequestration include direct removal of CO_2 from the atmosphere through

	land-use changes[15] and changes in forest management.
Significant Disturbance	Any natural impact that results in a loss of least 20% of the above-ground live biomass that is not the result of intentional or grossly negligent acts of the Forest Owner.
Sink	Physical unit or process that removes a GHG from the atmosphere.
Source	Physical unit or process that releases a GHG into the atmosphere.
Standing Dead Carbon Stocks	The carbon in standing dead trees. Standing dead trees include the stem, branches, roots, or section thereof, regardless of species, with minimum diameter (breast height) of five inches and a minimum height of 15 feet. Stumps are not considered standing dead stocks.
Standing Live Carbon Stocks	The carbon in the live tree pool. Live trees include the stem, branches, roots, and leaves or needles of all above ground live biomass,, regardless of species, with a minimum diameter (breast height) of five inches and a minimum height of 15 feet..
Stocks (or Carbon Stocks)	The quantity of carbon contained in identified carbon pools.
Submitted	The Reserve considers a Forest Project to be "submitted" when all of the appropriate forms have been uploaded and submitted to the Reserve's software system, and the Forest Owner has paid a project submission fee.
Tree	A woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of 5 inches and a minimum height of 15 feet with no branches within 3 feet from the ground at maturity.[16]
Unavoidable Reversal	An unavoidable reversal is any reversal not due to the Forest Owner's negligence, gross negligence or willful intent, including wildfires or disease that are not the result of the Forest Owner's negligence, gross negligence or willful intent.

[15] (Metz, Davidson, Swart, & Pan, 2001)
[16] (Helms 1998)

Uneven-Aged Management	Management that leads to forest stand conditions where the trees differ markedly in their ages, with trees of three or more distinct age classes either mixed or in small groups.
Verification	The process of reviewing and assessing all of a Forest Project's reported data and information by an ISO-accredited and Reserve-approved verification body, to confirm that the Forest Owner has adhered to the requirements of this protocol.
Verification Period	The period of time over which GHG reductions/removals are verified. A verification period may cover multiple reporting periods. The end date of any verification period must correspond to the end date of a reporting period.

12 References

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Appendix A Developing an Inventory of Forest Project Carbon Stocks

This appendix provides requirements for quantifying a Forest Project's forest carbon stocks. It explains how to identify the required and optional forest carbon pools measured in a Forest Project, as well as the steps necessary for quantifying the existing carbon stocks in the selected pools within the Project Area. Carbon inventory information serves two purposes:

1. It is used as the basis for modeling and estimating carbon stocks in a project's baseline (following the requirements of Section 6).
2. It is used to quantify actual carbon stocks during the course of a project.

This appendix explains the essential steps and requirements for completing a carbon inventory for all required and optional onsite carbon pools associated with a Forest Project.
Table A.4 contains a worksheet that must be followed to quantify the carbon in each pool.

A.1 Provide Background Information on Forest Area

To begin the inventory process, develop a general description of the activities and land use patterns that influence carbon stocks in the Project Area. This information will help inform the initial design of the forest inventory, as well as the estimations of carbon stocks. This information will be reviewed during verification.

At the time the Forest Project is first verified, the following information must be provided in map form (per Section 4), with the following information:

- Public and private roads
- Towns
- Major watercourses (4^{th} order or greater)
- Topography
- Townships, ranges, and sections or latitude and longitude

Additionally the following information about the Project Area must be provided in narrative form, with maps optional:

- Existing land cover and land use
- Forest vegetation types
- Site classes
- Land pressures and climate zone/classification

A.2 Measure Carbon Pools in the Project Area

Forest carbon pools are broadly grouped into the following categories:

1. Living biomass
2. Onsite dead biomass
3. Soil

Values for some of these categories of carbon will be determined through direct sampling. Table A.1 indicates the categories with their associated carbon pools and identifies which pools must be quantified for all projects versus those that may be excluded depending on the project. It also shows how the value for the pool is determined.

Table A.1. Reserve Requirements for Carbon Pool Categories and Determination of Value for Pool

Category	Carbon Pool	Forest Management	Reforestation	Avoided Conversion	Determination of Value
Living biomass	Standing Live	Required	Required*	Required	Sampled in Project
	Shrubs and Herbaceous Understory	Optional	Required	Optional	Sampled in Project
Onsite dead biomass	Standing Dead	Required	Required	Required	Sampled in Project
	Lying Dead Wood	Optional	Optional	Optional	Sampled in Project
	Litter	Optional	Optional	Optional	Sampled in Project
Soil	Soil**	Optional**	Optional**	Optional**	Sampled in project

* Pre-existing trees must be distinguished from planted trees. Since pre-existing and new trees are easy to distinguish for several decades after tree planting, pre-existing trees do not need to be inventoried until the Forest Owner first seeks verification of GHG reductions and removals (subsequent to the project's initial site-visit verification and registration).

** Soil carbon is not anticipated to change significantly as a result of most Forest Project activities. Soil carbon must be included in the inventory, however, if any of the following activities occur:

- Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or
- Mechanical site preparation activities are not conducted on contours.

A.3 Developing Onsite Forest Carbon Inventories

To develop estimates of carbon stocks in the carbon pools identified in Table A.1, a forest inventory must first be conducted. Standard forest inventories require the establishment of sample plots and provide inventory estimates in terms of cubic or board foot volume. These measurements are based on the species, trunk or bole diameter, form and height of the tree. A complete inventory must include a sampling methodology, a set of inventory plots, and analytical methods to translate field measurements into volume and/or biomass estimates.

Allometric Equations and Biomass/Carbon Mass Estimates

The equations in this appendix should be used for biomass and carbon mass estimations using the bole diameter and total height for live trees and sound standing dead trees. Estimates of lying dead and standing dead tree (for non-sound trees) biomass should be computed in terms of cubic volume and subsequently converted to biomass/carbon mass estimates. The Reserve may grant approval to use different volumetric and allometric equations than those presented here. The equations must be demonstrated to be more accurate within the project's Assessment Area than the equations currently in use by the USFS. The equations can only be approved by the Reserve after approval from the USFS will acknowledge in writing that the equation is an improvement. The Reserve will publish the improved equation and resulting measure of Common Practice for the Assessment Area. This is required to maintain consistency between

the estimates of Forest Project carbon stocks and the Reserve's estimates of Common Practice for Improved Forest Management Projects.

Sample Plots

The plot data used for deriving the estimates for verification must have been sampled within the last 12 years. The scheduling of plot sampling may occur in one time period or be distributed over several time periods. Either approach is acceptable so long as an inventory of the entire Project Area (its required carbon pools and corresponding sample plots) is completed within 12-year intervals.

An exception to the 12-year plot life is accepted where the Forest Owner can demonstrate to the verification body that the process utilized for updating the inventory, addressing both forest growth and harvest, adequately estimates the current inventory. To accomplish this, a statistically valid subsampling that has at least 10% of the plot numbers included in the updated inventory must be completed and determined to be the same as the updated inventory (updated using computer simulation that incorporates harvests) with a 90% confidence (α=0.10). Below is an example of the test assuming the plots are not paired and assuming they are paired. In no case shall any plot measurements be more than 18 years old.

The hypotheses are:

H_0: the subsample and updated inventory are the same
H_A: the subsample and updated inventory are not the same

The formula for the test statistic (t) is:

$$t = \frac{\bar{x}_u - \bar{x}_s}{s_{\bar{d}}}$$

Where: $\bar{x}_u$ = the updated carbon estimate from the original inventory

$\bar{x}_s$ = the subsample carbon estimate

$s_{\bar{d}}$ = the standard error of the difference between the two estimates (which is explained below for the situation where plots are unpaired and paired)

The standard error calculation for unpaired plots, which may occur with temporarily located plots, assumes that the variance is the same for both estimates since they are from the same population. The standard error estimate is given as:

$$s_{\bar{d}} = \sqrt{\frac{\left(\frac{n_u \times s_u^2 + n_s \times s_s^2}{n_u - 1 + n_s - 1}\right)}{n_u + n_s}}$$

Where: s_u^2 = the variance or standard deviation squared of the updated sample

s_s^2 = the variance or standard deviation squared of the subsample

n_u and n_s = the sample size of the updated inventory and subsample respectively

A one-tailed Students t-value is taken from a table using the α=0.10 and a degree of freedom of $n_u + n_s - 2$. If t < t(table) then accept H_0, otherwise reject H_0.

Where the plots are paired, as with re-measured permanent plots, then the standard error estimate is given as:

$$s_{\bar{d}}^2 = \sqrt{\frac{s_d^2}{n}}$$

Where: s_d^2 = the variance or standard deviation squared of the plot differences
n = the number of plots

The t-value from the table uses n - 1 degrees of freedom.

Steps for Developing a Complete Forest Carbon Inventory

The steps that follow provide more detailed guidance to establish and maintain a complete inventory and estimate carbon stocks. Results must be summarized in a table, as indicated in Step 8, for reports submitted to verification bodies and to the Reserve (see Section 9).

Step 1 – Developing Inventory Methodology and Sample Plots

Forest Owners must develop and describe a methodology to sample for biomass or volume of all required carbon pools. Sampling methodologies are also required for all included optional carbon pools, where a determination of the biomass or volume must be derived from sampling. Section 12 contains recommended references for developing sampling methodologies. If a pre-existing forest inventory is used to develop a Forest Project carbon inventory, all steps here must be followed to ensure the existing inventory meets the requirements of this protocol.

Sampling methodology and measurement standards should be consistent throughout the duration of the Forest Project. If new methodologies are adopted, they must achieve an equal or greater accuracy relative to the original sampling design. All sampling methodologies and measurement standards must be statistically sound and must be approved during verification.

Stratification is not required, but it may simplify verification and possibly lower the costs of verification. Temporary flagging of plot center, as is customary to allow for check cruising, is required to ensure ongoing inventory quality and allow for verifiers to visit plots when verifying inventory procedures. If permanent plots are used, which are statistically efficient for stock change estimates, permanent plot monumenting must be sufficient for relocation. Plot centers should be referenced on maps, preferably with GPS coordinates. The methodologies utilized must be documented and made available for verification and public review. The design of the sampling methodology and measurement standards must incorporate the requirements in the following table.

Table A.2. Minimum Required Sampling Criteria for Estimated Pools

Carbon Pool	Name of Requirement	Description of Requirement
Standing Live Trees (above-ground portion)	Diameter (breast height) Measurements	Stated minimum diameter in methodology not to be greater than 5 inches (12.7 cm).
	Measurement Tools	Description of tools used for height measurement, diameter measurement, and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for tree and plot size measurements.
	Plot Layout	A description of plot layout.
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be included in the sampling design.
	Allometric Equation used for Estimating Biomass	The methodology must include a description of the allometric equation used to estimate the whole tree biomass (bole, branches, and leaves) from bole diameter measurements. The use of functions other than those provided in the protocol will need to be approved by the verification body.
Standing Live Trees (below-ground portion)	Plot-level Allometric Equation used for Estimating Biomass	Apply model (Cairns, Brown, Helmer, & Baumgardner, 1997) to estimate below-ground biomass density. This model equation is based on above-ground biomass density in tonnes per hectare. The use of a function other than that provided in the protocol will need to be approved by the Reserve.
Herbaceous Understory	Sampling Methodology	The Reserve recommends the sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004). This methodology is referenced in Section 12. Alternative methodologies will need to be reviewed and approved by the Reserve.
Standing Dead Trees	Diameter (breast height) and top Diameter Measurements	Stated minimum breast height diameter in methodology not to be greater than 5 inches. The minimum height of standing dead trees is 15'. Description of how top diameter is derived.
	Measurement Tools	Description of tools used for height, diameter and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for height and diameter measurements.
	Plot Layout	A description of plot layout (may be the same layout as for live tree biomass).
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be including in the sampling design.
Litter and Duff	Sampling Methodology	The Reserve recommends the litter and duff methodology prepared by Brown, Shoch, Pearson, & Delaney (2004). This methodology is referenced in Section 12. Alternative methodologies will need to be reviewed and approved by the Reserve.
Lying Dead Wood	Diameter	Any piece(s) of dead woody material from a tree, e.g. dead boles, limbs, and large root masses, on the ground in forest stands. Lying dead wood is all dead tree material with a minimum average diameter of 5" and a

		minimum length of 8'. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood.
	Measurement Tools	Description of tools used for length, diameter and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for height and length measurements.
	Plot Layout	A description of plot layout (may be the same as the layout for live tree biomass).
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be including in the sampling design.
	Density by Decay Class	Description of methodology used to derive density estimates for each species (group) by wood density class.

Step 2 – Estimating Carbon in Live Trees from Sample Plots

Standing live tree carbon estimates are required for all projects. The standing live tree estimate includes carbon in all portions of the tree, including the bole, stump, bark, branches, leaves, and roots. The Forest Owner is responsible for determining appropriate methodologies for sampling to determine standing live tree carbon stocks. The estimate of above-ground live tree biomass must be combined with the estimates of biomass from other carbon pools to determine a mean estimate of the included pools derived from sampling, along with a summary that describes the statistical confidence of the estimate. Biomass estimates are converted to carbon estimates as described below.

The equations in Table A.3 are provided for a few common California species for estimating tree biomass from diameter (DBH) and total height (HT) measurements. This list does not contain all species that may be encountered in a Forest Project. The references in Section 12 contain a comprehensive list of biomass equations.[17]

For the equations below, diameter measurements are in inches and height measurements are in feet. The bole total volume (VOL) is calculated first and then multiplied by the wood density value for each species. This result is divided by 2.204622 to convert from pounds to kilograms. Conifer species have separate functions for bole, live crown, and bark biomass. Some hardwood species have volume functions that include these elements and therefore only one equation is used. The appropriate volume function for each species is cited in the references, which are Means, Hansen; Koerper, Alaback, & Klopsch (1994) and Waddell & Hiserote (2005).

Table A.3. Sample of the Equations for Tree Species Biomass Estimates

Species	Bole Biomass (kg)	Bark Biomass (kg)	Live Crown Biomass (kg)
Douglas-fir	(VOL x 28.70) / 2.204622	Exp(-4.3103+2.43 x ln(DBH x 2.54))	Exp(-3.6941+2.1382 x ln(DBH x 2.54))
Ponderosa pine	(VOL x 23.71) / 2.204622	Exp(-3.6263+1.34077 x ln(DBH x 2.54)+ 0.8567 x ln(HT x 0.3048))	Exp(-4.1068+1.5177 x ln(DBH x 2.54)+ 1.0424 x ln(HT x 0.3048))

[17] The Reserve may approve the application of equations that are more accurate and equally or more conservative than those referenced here, after receiving feedback from experts at USFS research stations.

Coast redwood	(VOL x 21.22) / 2.204622	Exp(7.189689+1.58375 x ln(DBH x 2.54))/1000	0.199+0.00381 x (DBH x 2.54)^2 x (HT x 0.3048)
Tanoak*	(VOL x 36.19) / 2.204622		

*Tanoak biomass is in one equation because it includes the bole, bark, and crown volumes.

The derived estimate of biomass must be multiplied by 0.5 to calculate the mass (kg) in carbon. This product must be multiplied by 0.001 tonnes/kg to convert the mass to metric tons of carbon.

Because of the difficulties associated with measuring the below-ground carbon component of trees, the Reserve allows for the estimation of this component of tree carbon through the use of a regression equation (Cairns, Brown, Helmer, & Baumgardner, 1997). This equation provides a practical and cost-effective approach that estimates below-ground biomass of standing live trees using the sampling-based calculation of above-ground biomass of standing live trees only:

BBD = exp(-0.7747 + 0.8836 x ln(ABD))

Where,

BBD = Below-ground biomass density of standing live trees in tonnes per hectare
ABD = Above-ground biomass density of standing live trees in tonnes per hectare

This equation must be applied at the plot level, after estimates of above-ground biomass have been calculated as described above.

Example A.1. Quantification Example (Part III – Tree Biomass)

The chart below displays summary data for tree biomass for the first plot in Strata 1.

Tree Biomass

1	2	3	4	5	6	7	8	9
Plot	Tree Number	Species	DBH (cm)	Total Height (m)	Status	Biomass (kg)	Weight (Expansion per Hectare)	Biomass (kg per Hectare)
1	1	Redwood	65	32	L	2,560	21	53,768
1	2	Douglas-fir	65	29	L	2,007	21	42,152
1	3	Tanoak	28	14	L	280	112	31,402
1	4	Redwood	68	30	L	2,677	19	50,858
1	5	Redwood	76	27	L	3,086	15	46,287
1	6	Douglas-fir	65	34	L	2,310	21	48,501
1	7	Tanoak	42	17	L	729	50	36,442
1	8	Tanoak	46	18	L	914	41	37,464
							Total	346,874

The plot in this example was measured using a 30 square foot basal area factor prism. The plot number is entered in column 1. All 'in' trees (trees on the plot) are measured and input consecutively starting at North and proceeding clockwise (this facilitates check cruising, quality control). Each tree is numbered (column 2), the species documented (column 3), the DBH measurements entered as centimeters in column 4, and the total height entered as meters in column 5.

The status of the tree goes in column 6. The status codes are shown below.

Status Codes	Description
L	Live
D1	Dead, with large and small branches and twigs
D2	Dead, with large and small branches and no twigs
D3	Dead, with large branches only
D4	Dead, with no branches

Only live trees are input into the Tree Biomass worksheet. The biomass for each tree is determined (column 7) using the volume, mass, and allometric equations provided in Step 2. The basal area factor and each tree's diameter (breast height) are used to determine the expansion factor, or weight, of each tree (column 8). The expansion factor is multiplied by each tree's biomass to portray the biomass estimate of each tree on a per hectare basis (column 9). Each tree's expanded biomass is summed to calculate the estimated total biomass in trees on plot 1. Plot 1's estimate of above-ground tree biomass in Strata 1 is calculated to be 346,874 kilograms per hectare. Based on this estimate, an estimate of below-ground biomass on a per hectare basis can be calculated using the equation above. The estimate of below-ground biomass is 80,918 kilograms per hectare. The combined estimate of biomass in Plot 1 is 427,792 kilograms per hectare.

Step 3 – Estimating Carbon Standing Dead Tree Carbon from Sample Plots

An inventory of carbon stocks in standing dead tree carbon is required for all Forest Projects. The Forest Owner must provide a sampling methodology for standing dead tree carbon as part of an overall sampling strategy (discussed in Step 1). References for developing sampling methodologies are included in Section 12. The estimate of standing dead tree carbon for highly decayed trees (broken tops, missing branches, etc.), must be calculated first volumetrically and subsequently converted to biomass and carbon tonnes. Sound dead trees can be computed using the equations provided for live trees in Step 2. The equations used in Step 2 provide an estimate of biomass in kilograms. The estimate must be converted to metric tons of carbon by multiplying the result by 0.001 tonnes/kg.

For those trees where volume is computed, the volume will need to be converted to biomass density by applying conversion factors based on a sub-sample of material that represents the species groups and decomposition classes. The methodology developed for both lying dead wood and standing dead biomass must include a description of the calculation techniques used to determine biomass density by decomposition classes and species groups. The estimate of biomass density must be computed in terms of metric tons of carbon on a per hectare basis. A description of a methodology to generate the density factors can be found in the Brown, Shoch, Pearson, & Delaney (2004) document mentioned in Table A.2. Alternatively, the density factors by decay class from Harmon et al (2008) may be used to estimate density in standing dead trees.

Step 4 – Estimating Carbon in Lying Dead Wood

The carbon content of lying dead wood, i.e. wood biomass that is not standing, is an optional pool for Forest Projects. Lying dead wood is defined as dead woody material with a minimum 5" average diameter and a minimum length of 8". As with standing dead wood, this category may not be present initially. It should be considered in the monitoring process and any projections of entity carbon stocks. References for developing sampling methodologies, which are referenced in Section 12, include Brown (1974), Harmon and Sexton (1996), and Brown, Shoch, Pearson, & Delaney (2004).

Field measurements of lying dead wood enable the calculation of volume to be easily computed. The computed volume will need to be converted to biomass density by applying conversion factors that may be based on default density values according to decay class found in Harmon et al. (2008) or a sub-sample of material that represents the species groups and decomposition classes. If direct sampling is used then the methodology developed for lying dead wood must include a description of the calculation techniques used to determine biomass density by decomposition classes and species groups. The estimate of biomass density must be computed in terms of carbon tonnes on a per hectare basis. The carbon tonnes estimate is inserted into the worksheet in this appendix. A description of a methodology to generate the density factors, if direct sampling is used, can be found in the Brown, Shoch, Pearson, & Delaney (2004) document.

The estimate of carbon tonnes for the lying dead pool and the standing dead pool may be summed with the live tree pool for each sampled plot. This will provide the basis for determining the overall carbon tonne estimate and descriptive statistics for the pools, including wood products, if applicable. The overall carbon tonne (per hectare) estimate of the required pools and the descriptive statistics are input into the worksheet in Step 10.

Example A.2. Quantification Example (Part V – Lying Dead Wood)

Lying dead wood is sampled on every plot. The chart below displays summary data for lying dead biomass for the first plot in Strata 1.

Strata 1										
Lying Dead Wood										
1	2	3	4	5	6	7	8	9	10	11
Plot	Log Number	Species	Large end Diameter	Small end Diameter	Total Length on plot (mt)	Density	Volume (cubic meters)	Biomass (kg)	Weight (per Hectare)	Total Biomass per Hectare
1	1	Tanoak	30	15	3.6	Rotten	0.6	24.0	25	600
1	2	Redwood	109	96	2.3	Sound	1.9	684.0	25	17,100
							Sum			17,700

The sampling method used in this example is a fixed area plot. The area sampled is a 1/25th hectare plot. The entries in the columns are similar to those already discussed for trees and standing dead trees. The volume in lying dead wood is calculated first and subsequently converted to biomass using the coefficients developed from the density sub-samples.

The sum of the per hectare biomass estimates from the tree, standing dead, and lying dead biomass are summed to determine the combined biomass estimate on Plot 1. The result of summing this example is shown below.

Plot 1		
Carbon Pool	**Biomass Sum per Hectare (kg)**	**Metric Tons of Carbon per Hectare**
Trees	427,792	213.9
Standing Dead	57,054	28.5
Lying Dead	17,700	8.9

Total Biomass	502,546	251.3

The biomass sums are multiplied by 0.5 to convert to carbon biomass and subsequently by 0.001 tonnes/kg to convert to metric tons of carbon, as described in Step 2. This process is completed for all plots in Strata 1 and Strata 2. The sample results from Plot 1 indicate that there are 251 carbon tonnes per hectare.

Step 5 – Estimate Carbon in Shrubs and Herbaceous Understory from Sample Plots

Any methodology developed for measuring carbon in shrubs must be reviewed during verification. Section 12 provides a reference that can be used to predict above-ground biomass of plant species in early successional forests of the western Cascade Ranges. Inventory estimates for shrubs must be computed in terms of metric tons of carbon.

The most applicable biomass estimation methods may be used, including photo series, the estimation functions from published papers, direct sampling, or combinations of approaches.

Step 6 – Estimate of Carbon in Litter and Duff

Litter is the dead plant material that can still be identified as leaves, grasses and small branches. The largest material that can be considered litter is the minimum diameter stated in the Forest Project's approved methodology for lying dead wood. The duff layer is the organic material layer at the soil surface under the litter layer. The duff layer consists of dead plant materials that cannot be identified as leaves, grasses, and small branches. Carbon stock estimates must be computed in terms of metric tons of carbon. The mean estimate is input into the Litter and Duff Section in the worksheet in Step 8 on a per hectare basis.

The most applicable biomass estimation methods may be used, including photo series, the estimation functions from published papers, direct sampling, or combinations of approaches.

Step 7 – Estimate of Carbon Tonnes in Soil

Changes in total soil carbon are a challenge to measure over short timeframes, as this pool changes slowly and is usually dependent on the rate of biomass input relative to soil decomposition. The sampling methodology and protocols for deriving carbon estimates in soil must be developed as part of an overall sampling strategy (discussed in Step 2). The Reserve recommends the soil sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004) that can be found in Section 12.

Estimates must be computed in terms of metric tons of carbon.

Step 8 – Sum Carbon Pools

The metric tons of carbon in each carbon pool, as derived from the preceding steps, must be entered in the following table. For the purpose of quantifying GHG reductions and removals in Section 6, all numbers must be converted to metric tons of CO_2-equivalent by multiplying by 3.67.

Table A.4. Worksheet for Summarizing Carbon Pools and Calculating Total Carbon

Carbon Pool	Gross Carbon Tonnes per Hectare	Gross CO_2-equivalent Tonnes per Hectare
Step 2 Live Trees	From sampling results of trees.	
Steps 3 – 4 Standing Dead Trees, and Lying Dead Wood	From sampling results of standing dead biomass and lying dead biomass.	
Step 6 Shrubs and Herbaceous Understory	From sampling results of shrubs and herbaceous understory.	
Step 7 Litter and Duff	From sampling results of litter and duff.	
Step 8 Soil	From sampling results of soil.	
Sum of CO_2-equivalent Tonnes from Included Pools		

A.4 Applying a Confidence Deduction

Any forest carbon inventory estimate will be subject to statistical uncertainty. Where statistical confidence is low, there is a higher risk of overestimating a project's actual carbon stocks and therefore a higher risk of over-quantifying GHG reductions and removals. To help ensure that estimates of GHG reductions and removals are conservative, Forest Owners are required each year to apply a confidence deduction to the inventory of actual onsite carbon stocks. A confidence deduction is *not* applied to the forest carbon inventory when it is used to model baseline carbon stocks.

To determine the appropriate confidence deduction, the Forest Owner must perform the following:

1. Compute the standard error of the inventory estimate (based on the carbon in standing live and standing dead carbon pools).
2. Multiply the standard error by 1.645.
3. Divide the total inventory estimate by the result in (2) and multiply by 100. This establishes the sampling error (expressed as a percentage of the mean inventory estimate from field sampling) for a 90% confidence interval.
4. Consult Table A.5 to identify the percent confidence deduction that must be applied to the inventory estimate for the purpose of calculating GHG reductions and removals (i.e. variable CD_y in Equation 6.1 in Section 6).

Table A.5. Forest Carbon Inventory Confidence Deductions Based on Level of Confidence in the Estimate Derived from Field Sampling

Sampling Error (% of Inventory Estimate)	Confidence Deduction
0 to 5%	0%
5.1 to 20%	(Sampling Error – 5.0%) to the nearest 1/10th percentage
20% or greater*	100%
* Projects with sampling errors that are 20% or greater are not eligible.	

The confidence deduction must be updated each time the project is subject to a site-visit verification (see Section 10), but must remain unchanged between verification site visits. If increased sampling over time results in a lower confidence deduction at the time of a site-visit verification, the lower deduction may be applied to inventory estimates in all previous years. The Reserve will issue CRTs in the current year for any increase in quantified GHG reductions and removals in prior years associated with the new (lower) confidence deduction. Conversely, if a loss of qualified sampling plots results in a higher confidence deduction, this higher deduction must also be applied to inventory estimates in all previous years. Any resulting decrease in creditable GHG reductions and removals for prior years will be treated as an avoidable reversal, and must be compensated for by retiring CRTs in accordance with Section 7.3.2.

Appendix B Modeling Carbon Stocks

This protocol requires the use of certain empirical-based models to estimate the baseline carbon stocks and project stocks of selected carbon pools within the Project Area. These models may also be used to supplement assessments of actual changes in carbon stocks resulting from the Forest Project.

B.1 About Models and Their Eligibility for Use with Forest Projects

Empirical-based models are used for estimating existing values where direct sampling is not possible or cost-effective. They are also used to forecast the estimations derived from direct sampling into the future. Field measurements provide the basis for inferring value through the use of these models.

The models that simulate growth projections have two basic functions in the development and management of a Forest Project. Models project the results of direct sampling through simulated forest management activity. These models, often referred to as growth and yield simulation models, may project information regarding tree growth, harvesting, and mortality over time – values that must ultimately be converted into carbon in an additional step. Other models may combine steps and estimate tree growth and mortality, as well as changes in other carbon pools and conversions to carbon, to create estimated projections of carbon stocks over time.

Models are also used to assist in updating inventory plots so that the plots can represent a reporting year subsequent to their actual sample date. The model simulates the diameter and height increment of sampled trees for the length of time between their sampled date and the reporting year. The limit to the use of models for updating plot data is described in Appendix A.

The following growth models have been approved:

- CACTOS: California Conifer Timber Output Simulator
- CRYPTOS: Cooperative Redwood Yield and Timber Output Simulator
- FVS: Forest Vegetation Simulator
- SPS: Stand Projection System
- FPS: Forest Projection System
- FREIGHTS: Forest Resource Inventory, Growth, and Harvest Tracking System
- CRYPTOS Emulator
- FORESEE

A Forest Owner may update inventory plot data for estimating diameter and height growth by incorporating data obtained from sample plots, as in a stand table projection. To qualify for this method:

- The Project Area shall be stratified into even-age management and uneven-age management.
- Diameter increment shall be based on the average annual increment of a minimum of 20 samples of radial growth for diameter increment for each 8” DBH (Diameter at Breast Height) class, beginning at 0 – 8” DBH for each management (even-age or uneven-age) type. The average annual increment shall be added for each year according to the plot’s sample date.
- Height increment shall be based on regression curves for each management type (even-age or uneven-age) developed from height measurements from the same trees the diameter increment data was obtained. The estimated height shall be determined using the regression estimators for the ‘grown’ diameters as described above.

Forest Owners incorporating this methodology are not eligible for extensions of plot life as described in Appendix A.

The Reserve may include additional models following approval of a state forestry authority (i.e. a state agency responsible for oversight of forests) who will acknowledge in writing that the model:

- Has been peer reviewed in a process that: 1) primarily involved reviewers with necessary technical expertise (e.g. modeling specialists and relevant fields of biology, forestry, ecology, etc.), and 2) was open and rigorous
- Is parameterized for the specific conditions of the Project Area
- Limits use to the scope for which the model was developed and evaluated
- Is clearly documented with respect to the scope of the model, assumptions, known limitations, embedded hypotheses, assessment of uncertainties, and sources for equations, data sets, factors or parameters, etc.
- Underwent a sensitivity analysis to assess model behavior for the range of parameters for which the model is applied
- Is periodically reviewed (Prisley & Mortimer, 2004)

B.2 Using models to forecast carbon stocks

The use of simulation models is required for estimating a Forest Project's baseline carbon stocks. Models may also be required to forecast actual carbon stocks expected under the Forest Project (e.g. in conjunction with determining expected harvesting volumes or in updating forest carbon inventories).

Inventory information from Appendix A must be incorporated into the simulation models to project carbon stocks over time. If a model has the ability to convert biomass to carbon, it must include all the carbon pools required by this protocol.

Projected baseline or actual carbon stocks must be portrayed in a graph depicting time in the x-axis and carbon tonnes in the y-axis. Baseline carbon stocks must be projected forward from the date of the Forest Project's initiation. The graph should be supported with written characterizations that explain any annual changes in baseline carbon stocks over time. These characterizations must be consistent with the baseline analysis required in Section 6.

B.3 Modeling Requirements

A modeling plan must be prepared that addresses all required forecasting or updating of baseline and actual carbon stocks for the Forest Project. The modeling plan shall contain the following elements:

1. A description of all silviculture methods modeled. The description of each silviculture method will include:
    a. A description of the trees retained (by species groups if appropriate) at harvest.
    b. The harvest frequency (years between harvests).
    c. Regeneration assumptions.
2. A list of all legal constraints that affect management activities on the Project Area. This list must identify and describe the constraint and discuss the silviculture methods that will be modeled to ensure the constraint is respected.
3. A description of the site indexes used for each species and an explanation of the source of the site index values used.

4. A description of the model used and an explanation of how the model was calibrated for local use, if applicable.

Modeling outputs must include:

1. Periodic harvest, inventory, and growth estimates for the entire Project Area presented as total carbon tonnes and carbon tonnes per acre.
2. Harvest yield streams on modeled stands, averaged by silviculture method and constraints, which must include the period over which the harvest occurred and the estimated volume of wood removed.

Appendix C Estimating Carbon in Wood Products

Wood products may constitute a reservoir for storing carbon over the long term. Projects that increase wood product production can receive credit for the resulting incremental carbon storage. By the same token, projects that reduce wood product production must account for the incremental *reduction* in stored wood product carbon. As indicated in Section 7, the Reserve requires that GHG reductions and removals be effectively "permanent," meaning that sequestered carbon associated with GHG reductions and removals must remain stored for at least 100 years. Wood product carbon is estimated by calculating the average amount of carbon that is likely to remain stored in wood products over a 100-year period.

The processes described here are adapted from the 1605(b) methodology (U.S. Department of Energy, 2007) for accounting for the long-term storage of wood products. Please see Smith, Heath, Skog, & Birdsey (2006) for a more detailed description since the 1605(b) procedure was adapted from this publication.

Because of the significant uncertainties associated with predicting wood product carbon storage over 100 years, the accounting requirements in this appendix are designed to err on the side of conservativeness. This means the calculations are designed to reduce the risk of overestimating the GHG reductions and removals achieved by a Forest Project. One of the largest sources of uncertainty is predicting the amount of wood product carbon likely to be stored in landfills. To accommodate this uncertainty, and ensure that Forest Project GHG reductions and removals are accounted for conservatively:

1. Landfill carbon storage is *excluded* from calculations of wood-product carbon in years where a Forest Project's actual harvesting volumes exceed estimated baseline harvesting volumes, as determined in Section 6.
2. Landfill carbon storage is *included* in calculations of wood-product carbon in years where a Forest Project's actual harvesting volumes are below estimated baseline harvesting volumes, as determined in Section 6.

Accounting for wood product carbon must be applied only to actual or baseline volumes of wood harvested from within the Project Area. Trees harvested outside of the Project Area are not part of the Forest Project and must be excluded from any calculations.

There are five steps required to determine carbon stored in wood products:

1. Determining the amount of carbon in harvested wood that is delivered to mills
2. Accounting for mill efficiencies
3. Estimating average carbon storage over 100 years in in-use wood products
4. Estimating average carbon storage over 100 years in wood products in landfills (when applicable)
5. Summing the results to determine total average carbon storage over 100 years

C.1 Determine the Amount of Carbon in Harvested Wood Delivered to Mills

The following steps must be followed to determine the amount of carbon in harvested wood:

1. Determine the amount of wood harvested (actual or baseline) that will be delivered to mills, by volume (cubic feet) or by green weight (lbs), and by species for the current year (y). In all cases, harvested wood volumes and/or weights must exclude bark.

   a. Baseline harvested wood volumes and species are derived from modeling a baseline harvesting scenario, following the requirements in Section 6.
   b. Actual harvested wood volumes and species must be based on verified third-party scaling reports, where available. Where not available the Forest Owner must provide documentation to support the quantity of wood volume harvested.
2. If a volume measurement is used, multiply the cubic foot volume by the appropriate wood density factor in Table C.1 (for projects located in the Pacific Southwest) or from the USFS Wood Handbook (other regions).[18] This results in pounds of biomass with zero moisture content.
3. If a weight measurement is used, subtract the water weight based on the moisture content of the wood. This results in pounds of biomass with zero moisture content.
4. Sum the dry weights for each harvested species to get a total dry weight for all harvested wood.
5. Multiply this total value by 0.5 pounds of carbon/pound of wood to compute the total carbon weight.
6. Divide the total carbon weight by 2,204.6 pounds/metric ton to convert to metric tons of carbon. This value is used in the next step, accounting for mill efficiencies.

Table C.1. Specific Gravity and Wood Density of Green Softwoods and Hardwoods by Forest Type for the Pacific Southwest from 1605(b) Methodology (DOE, 2007, Table 1.4)

Forest Type	Specific Gravity of Softwoods	Specific Gravity of Hardwoods	Wood Density of Softwoods (lbs/ft^3)	Wood Density of Hardwoods (lbs/ft^3)
Mixed conifer	0.394	0.521	24.59	32.51
Douglas-fir	0.429	0.483	26.77	30.14
Fir-spruce-hemlock	0.372	0.510	23.21	31.82
Ponderosa pine	0.380	0.510	23.71	31.82
Redwood	0.376	0.449	23.46	28.02

C.2 Account for Mill Efficiencies

Multiply the total carbon weight (metric tons of carbon) derived in C.1 by the mill efficiency identified for the project's Assessment Area from the most current Assessment Area Data File, available on the Forest Project Protocol Resources section of the Reserve's website. This is the total carbon transferred into wood products. The remainder of the harvested carbon is considered to be immediately emitted to the atmosphere for accounting purposes in this protocol.

C.3 Estimate the Average Carbon Storage Over 100 Years in In-Use Wood Products

The amount of carbon that will remain stored in in-use wood products for at least 100 years depends on the rate at which wood products either decay or are sent to landfills. Decay rates depend on the type of wood product that is produced. Thus, in order to account for the

[18] The Wood Handbook (USFS, 1999) contains specific gravities for tree species in other regions. Multiply the specific gravity by the density of water (62.4 lbs/ft^3) to get wood density.

decomposition of harvested wood over time, a decay rate is applied to wood products according to their product class. To approximate the climate benefits of carbon storage, this protocol accounts for the average amount of carbon stored over 100 years. Thus, decay rates for each wood product class have been converted into "average storage factors" in Table C.2, below.

To determine the average carbon storage in in-use wood products over 100 years, the first step is to determine what percentage of a Project Area's harvest will end up in each wood product class (Columns A-G in Table C.2). This must be done by either:

1. Obtaining a verified report from the mill(s) where the Project Area's logs are sold indicating the product categories the mill(s) sold for the year in question; or
2. If a verified report cannot be obtained, looking up default wood product classes for the project's Assessment Area, as given in the most current Assessment Area Data File, available on the Forest Project Protocol Resources section of the Reserve's website.

If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous".

Once the breakdown of in-use wood product categories is determined, use the worksheet in Table C.2 to estimate the average amount of carbon stored in in-use wood products over 100 years:

1. Assign a percentage to each product class (columns A-G) according to mill data or default values for the project.
2. Multiply the total carbon transferred into wood products (determined in Section C.2) by the percentages in each column and insert the resulting values into boxes 3A through 3G.
3. Multiply the values in 3A-3G by the 100-year average storage factor and insert the results into boxes 4A through 4G.
4. Use Equation C.1 to calculate the average carbon stored in in-use wood products over 100 years (in units of CO_2-equivalent metric tons).

Equation C.1. Average Carbon Stored in In-Use Wood Products

$$\mathbf{WP_{in\text{-}use,\,y} = \sum(Table\ C.2,\ Row\ 4) \times 3.67}$$

Where,

$WP_{in\text{-}use,\,y}$ = Average carbon stored in in-use wood products over 100 years from wood harvested in year y (actual or baseline)

Table C.2. Worksheet to Estimate Long-Term Carbon Storage in In-Use Wood Products

	A	B	C	D	E	F	G
Wood Product Class	Softwood Lumber	Hardwood lumber	Softwood Plywood	Oriented Strandboard	Non Structural Panels	Miscellaneous Products	Paper
% in each class	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)

Metric tons C in each class	(3A)	(3B)	(3C)	(3D)	(3E)	(3F)	(3G)
100-year average storage factor (in-use)	0.463	0.250	0.484	0.582	0.380	0.176	0.058
Average C stored in in-use wood products (metric tons)	(4A)	(4B)	(4C)	(4D)	(4E)	(4F)	(4G)

C.4 Estimate the Average Carbon Storage Over 100 Years for Wood Products in Landfills

Wood product carbon in landfills is only calculated for years in which a Forest Project's actual harvesting volumes are below estimated baseline harvesting levels, as determined in Section 6. To determine the appropriate value for average landfill carbon storage, perform the following steps:

Step 1 – Calculate the average carbon storage over 100 years for wood products in landfills

Use the worksheet in Table C.3 to estimate the average amount of wood product carbon stored in landfills over 100 years:

1. Assign a percentage to each product class (columns A-G) according to mill data or default values for the project (as determined in Section C.3).
2. Multiply the total carbon transferred into wood products (determined in Section C.2) by the percentages in each column and insert the resulting values into boxes 3A through 3G.
3. Multiply the values in 3A-3G by the 100-year average storage factor for landfill carbon and insert the results into boxes 4A through 4G.

Table C.3. Worksheet to Estimate Long-Term Carbon Storage in Wood Products in Landfills

Wood Product Class	A Softwood Lumber	B Hardwood lumber	C Softwood Plywood	D Oriented Strandboard	E Non Structural Panels	F Miscellaneous Products	G Paper
% in each class	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)
Metric tons C in each class	(3A)	(3B)	(3C)	(3D)	(3E)	(3F)	(3G)
100-year average storage factor (landfills)	0.298	0.414	0.287	0.233	0.344	0.454	0.178
Average C stored in landfills (metric tons)	(4A)	(4B)	(4C)	(4D)	(4E)	(4F)	(4G)

Step 2 – Determine the appropriate value to use for wood product carbon in landfills

Use Equation C.2 to determine the appropriate value for the average wood product carbon stored in landfills over 100 years (in units of CO_2-equivalent metric tons).

Equation C.2. Average Wood Product Carbon Stored in Landfills

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) < 0, then\ WP_{landfill,y} = \sum (Table\ C.3, Row\ 4) \times 3.67$$

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) > 0, then\ WP_{landfill,y} = 0$$

Where,

$WP_{landfill,\ y}$	=	Average carbon stored in wood products in landfills over 100 years from wood harvested in the current year/reporting period (actual or baseline)
$AC_{hv,\ n}$	=	Actual amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tonnes
$BC_{hv,\ n}$	=	Estimated average baseline amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tonnes
y	=	The current year or reporting period

C.5 Determine Total Average Carbon Storage in Wood Products Over 100 Years

The total average carbon storage in wood products over 100 years for a given harvest volume (as determined in Section C.1) must be calculated and reported as follows (Equation C.3). The value derived for WP_{total} must be used for actual and baseline wood product carbon estimates ($AC_{wp,y}$ or $BC_{wp,y}$ in Equation 6.1) as appropriate, following the guidance in Section 6.

Equation C.3. Total Average Carbon Stored in Wood Products

$$\mathbf{WP_{total,\ y} = WP_{in\text{-}use,\ y} + WP_{landfill,\ y}}$$

Where,

$WP_{total,\ y}$	=	Average carbon stored over 100 years from wood harvested in year y (actual or baseline)
$\mathbf{WP_{in\text{-}use,\ y}}$	=	Average carbon stored in in-use wood products over 100 years from wood harvested in year y (actual or baseline)
$\mathbf{WP_{landfill,\ y}}$	=	Average carbon stored in wood products in landfills over 100 years from wood harvested in year y (actual or baseline)

Appendix D Determination of a Forest Project's Reversal Risk Rating

Forest Owners must derive a reversal risk rating for their Forest Project using the worksheets in this section. The worksheets are designed to identify and quantify the specific types of risks that may lead to a reversal, based on project-specific factors.

This risk assessment must be updated every time the project undergoes a verification site visit. Therefore, a project's risk profile and its assessment are dynamic. Furthermore, estimated risk values and associated mitigation measures will be updated periodically by the Reserve as improvements in quantifying risks or changes in risks are determined. Any adjustments to the risk ratings will affect only current and future year contributions to the Buffer Pool. The Reserve may, from time to time, transfer CRTs from the Buffer Pool to the Forest Owner's account if the Reserve determines that previously assessed risk ratings were unnecessarily high. Alternatively, the Reserve may waive a Forest Owner's future contributions to the Buffer Pool until excess contributions from previous years are recouped. If a Forest Project's risk rating increases, the Forest Owner must contribute additional CRTs to the Buffer Pool to ensure that all CRTs (including those issued in prior years) are properly insured.

Risks that may lead to reversals are classified into the categories identified in Table D.1.

Table D.1. Forest Project Risk Types

Risk Category	Risk Type	Description	How Risk is Managed in this Protocol
Financial	Financial Failure Leading to Bankruptcy	Financial failure can lead to bankruptcy and/or alternative management decisions to generate income that result in reversals through over-harvesting or conversion	Default Risk
Management	Illegal Harvesting	Loss of project stocks due to timber theft	Default by Area
	Conversion to Non-Forest Uses	Alternative land uses are exercised at project carbon expense	Default Risk
	Over-Harvesting	Exercising timber value at expense of project carbon	Default Risk
Social	Social Risks	Changing government policies, regulations, and general economic conditions	Default Risk
Natural Disturbance	Wildfire	Loss of project carbon through wildfire	Risk and Risk-Mitigation Worksheet
	Disease/Insects	Loss of project carbon through disease and/or insects	Default Risk
	Other Episodic	Loss of project carbon from wind,	Default Risk

	Catastrophic Events	snow and ice, or flooding events	

D.1 Financial Risk

Financial failure of an organization resulting in bankruptcy can lead to dissolution of agreements and forest management activities to recover losses that result in reversals. Projects that employ a Qualified Conservation Easement or Qualified Deed Restriction, or that occur on public lands, are at a lower risk than projects with a PIA alone.

Table D.2. Financial Risk Identification

Applies to all projects		
Identification of Risk	**Contribution to Reversal Risk Rating**	
	PIA only	**PIA combined with Qualified Conservation Easement or Qualified Deed Restriction or on public lands**
Default Financial Risk	5%	1%

D.2 Management Risk

Management failure is the risk of management activities that directly or indirectly could lead to a reversal. Projects that employ a conservation easement or deed restriction, or that occur on public lands, are exempt from this risk category.

Management Risk I – Illegal Removals of Forest Biomass

Illegal logging occurs when biomass is removed either by trespass or outside of a planned set of management activities that are controlled by regulation. Illegal logging is exacerbated by lack of controls and enforcement activities.

Table D.3. Risk of Illegal Removals of Forest Biomass

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
United States Default Harvesting Risk	0%

Management Risk II – Conversion of Project Area to Alternative Land Uses

High values for development of housing and/or agriculture may compete with timber and carbon values and lead to a change in land use that affects carbon stocks. The risk of conversion of any Project Area to other non-forest uses is related to the probability of alternative uses, which are affected by many variables, including population growth, topography, proximity to provisions

and metropolitan areas, availability of water and power, and quality of access to the Project Area.

Table D.4. Risk of Conversion to Alternative Land Use

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
With Qualified Conservation Easement or Qualified Deed Restriction that explicitly encumbers all development rights	0%
Without Qualified Conservation Easement or Qualified Deed Restriction	2%

Management Risk III – Over-Harvesting

Favorable timber values, among other reasons, may motivate some project managers to realize timber values at the expense of managing carbon stocks for which CRTs have been credited. Additionally, reversals can occur as the result of harvest associated with fuels treatments.

Table D.5. Risk of Over-Harvesting

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
With Qualified Conservation Easement or Qualified Deed Restriction that explicitly encumbers timber harvesting associated with project stocks	0%
Without Qualified Conservation Easement or Qualified Deed Restriction	2%

D.3 Social Risk

Social risks exist due to changing government policies, regulations, and general economic conditions. The risks of social or political actions leading to reversals are low, but could be significant.

Table D.6. Social Risk Identification

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
United States Default Social Risk	2%

D.4 Natural Disturbance Risk

Natural disturbances can pose a significant risk to the permanency GHG reductions and removals. Natural disturbance risks are only partially controllable by management activities.

Management activities that improve resiliency to wildfire, insects, and disease can reduce these risks. Management activities that shift harvesting practices from live sequestering trees to trees that have succumbed to natural disturbances reduce or negate the reversal depending on the size and location of the disturbance.

Natural Disturbance Risk I – Wildfire

A wildfire has the potential to cause significant reversals, especially in certain carbon pools. These risks can be reduced by certain techniques including reducing surface fuel loads, removing ladder fuels, adding fuel breaks, and reducing stand density. However, these techniques cannot reduce emission risk to zero because all landowners will not undertake fuel treatments, nor can they prevent wildfire from occurring.

Table D.7. Natural Disturbance Risk I – Wildfire

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
For the Assessment Area the project is located in, determine long-term fire risk potential from fire history perimeter maps (at least 30 years) – enter rate as an annualized percentage.*	X%
If fuel treatments have been implemented for the Project Area, reduce the value above by the appropriate % as indicated below.**	(X%) **x** Y%

* If the project proponent has more property specific fire data of at least 30 years in duration that may be used in lieu of the regional Assessment Area values.
** Depending on the level of fuel treatments the Y% is set as follows: high level of fuel treatments = 50%, medium level of fuel treatments = 66.3%, low level of fuel treatments = 82.6%, no fuel treatments = 100%.

Natural Disturbance Risk II - Disease or Insect Outbreak

A disease or insect outbreak has the potential to cause a reversal, especially in certain carbon pools.

Table D.8. Natural Disturbance Risk II – Disease or Insect Outbreak

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
Default Risk Contribution from Disease or Insect Outbreak	3%

Natural Disturbance Risk III - Other Episodic Catastrophic Events

A major wind-throw event (hurricane, tornado, high wind event) has the potential to cause a reversal, especially in certain carbon pools.

Table D.9. Natural Disturbance Risk III – Other Episodic Catastrophic Events

Applies to all projects

Identification of Risk	Contribution to Reversal Risk Rating
Default Risk Contribution from Other Catastrophic Events	3%

D.5 Summarizing the Risk Analysis and Contribution to Buffer Pool

Use the table below to summarize the Forest Project's reversal risk rating. As indicated above, projects that employ a conservation easement or deed restriction, or that occur on public lands, are exempt from certain risk categories. Such Qualified Conservation Easements and Qualified Deed Restrictions must clearly identify the goals and objectives of the Forest Project according to the terms of this protocol.

Table D.10. Project Contribution to the Buffer Pool Based on Risk

Risk Category	Contribution from Risk Descriptions Above		
	Source	PIA Only	PIA and Qualified Conservation Easement and/or a Qualified Deed Restriction and/or Public Ownership
Financial Failure	Default Risk -Remedies for reversals addressed in PIA	5%	1%
Illegal Forest Biomass Removal	Default Risk	0%	0%
Conversion	Default Risk - Remedies for reversals addressed in PIA	2%	0%
Over-Harvesting	Default Risk - Remedies for reversals addressed in PIA	2%	0%
Social	Default Risk	2%	2%
Wildfire	Calculated Risk from worksheet	X%	X%
Disease or Insect Outbreak	Calculated Risk from worksheet	3%	3%
Other Catastrophic Events	Calculated Risk from worksheet	3%	3%

Completing the Risk Rating Analysis:

The project's reversal risk rating is calculated as follows:

$$100\% - \left(\begin{array}{l} (-FinancialFailure\%) \times (-IllegalForestBiomassRemoval\%) \times (-Conversion\%) \\ \times (-OverHarvesting\%) \times (-SocialRisk\%) \times (-Wildfire\%) \times (-Disease/InsectOutbreak\%) \\ \times (-OtherCatastrophicEvents\%) \end{array} \right)$$

Appendix E Reforestation Project Eligibility

This appendix presents a standardized approach to determine whether reforestation activities on lands that have undergone a Significant Disturbance are likely to be Business As Usual – and therefore not eligible for registration with the Reserve – based on the net present value for the timber expected to be produced from reforestation. A Reforestation Project is considered Business As Usual if the net present value for expected timber is $0 or more according to standard assumptions underlying Table E.1.

To determine whether a Reforestation Project is eligible, perform the following steps:

1. Identify whether site preparation costs[19] are High or Low:
    a. Site preparation costs are High if:
        i. Competing species management (including mechanical removal and/or use of herbicides) has been or will be conducted on 50% or more of the Project Area; or
        ii. Soil ripping has occurred on more than 50% of the Project Area.
    b. Site preparation costs are Low for all other projects.
2. Identify the value of harvested products (High, Medium, Low, or Very Low) corresponding to the project's Assessment Area, from the lookup table in the most current Assessment Area Data File, available on the Forest Project Protocol Resources section of the Reserve's website.
3. Identify the standard Rotation Age for the project's Assessment Area, from the lookup table in the most current Assessment Area Data File, available on the Forest Project Protocol Resources section of the Reserve's website.
4. Identify the site class category for the Project Area. The category must be consistent with the stated site productivity in the project's submission form to the Reserve. Projects with mixed site classes must round to the nearest site class category based on a weighted average.
    a. Site Classes I and II are classified as 'Higher'.
    b. Site Classes III, IV, and V are classified as 'Lower'.
5. Determine whether the project is "eligible" or "not eligible" according to the identified site preparation costs, value of harvested products, rotation age, and site class, as indicated in Table E.1.

[19] All projects are assumed to have similar costs related to the cost of seedlings and planting; site preparation costs, however, can vary depending on circumstances.

Table E.1. Determination of Reforestation Project Eligibility

Site Preparation Costs	Value of Harvested Products	Rotation Age (Years)	Site Class	Eligibility	Scenario #
High Site Preparation	High	<60	Higher	Not Eligible	1
			Lower	Not Eligible	2
		>=60	Higher	Eligible	3
			Lower	Eligible	4
	Medium	<50	Higher	Not Eligible	5
			Lower	Not Eligible	6
		50 - 59	Higher	Not Eligible	7
			Lower	Eligible	8
		>=60	Higher	Eligible	9
			Lower	Eligible	10
	Low	<30	Higher	Not Eligible	11
			Lower	Eligible	12
		>=30	Higher	Eligible	13
			Lower	Eligible	14
	Very Low	>=30	Higher	Eligible	15
			Lower	Eligible	16
Low Site Preparation	High	<60	Higher	Not Eligible	17
			Lower	Not Eligible	18
		60 - 69	Higher	Not Eligible	19
			Lower	Eligible	20
		>=70	Higher	Eligible	21
			Lower	Eligible	22
	Medium	<50	Higher	Not Eligible	23
			Lower	Not Eligible	24
		50 - 59	Higher	Not Eligible	25
			Lower	Eligible	26
		>=60	Higher	Eligible	27
			Lower	Eligible	28
	Low	< 30	Higher	Not Eligible	29
			Lower	Not Eligible	30
		30 - 49	Higher	Not Eligible	31
			Lower	Eligible	32
		>=50	Higher	Eligible	33
			Lower	Eligible	34
	Very Low	>=30	Higher	Eligible	35
			Lower	Eligible	36
		<30	Higher	Not Eligible	37
			Lower	Not Eligible	38

Appendix F Determining A Value for Common Practice

The following guidance provides step by step instructions for determining the appropriate Common Practice value for an Improved Forest Management project based on its geographic location and boundaries.

1. **Determine the Geographic Supersection Within Which the Project Area is Located**

   Forest Owners must determine the geographic Supersection within which the Project Area is located by consulting maps of Supersections provided by the Reserve. These maps can be downloaded from the Forest Project Protocol Resources section of the Reserve's website in either a .pdf format or a Geographical Information System (GIS) shapefile.

2. **Determine the Acreage of the Project Area That Falls Within Each Assessment Area Contained in the Supersection**

   Supersections may consist of one or many Assessment Areas. Assessment Areas are groupings of tree species that are commonly found in association with each other, as in a vegetation community. Assessment Areas are not mapped since the geographic locations of forest communities vary based on highly resolute environmental variables. To determine which Assessment Areas are included within the Project Area, compare the tree species in the Project Area to the species list associated with each Assessment Area in the project's Supersection (identified in Step 1). Tree species information must be looked up using the most current Assessment Area Data File from the Forest Project Protocol Resources section of the Reserve's website. The minimum mapping resolution for vegetation communities is 20 acres. Therefore, any contiguous area 20 acres or greater within the Project Area that consists of a separate vegetation community must be independently mapped. For a Forest Project to be eligible, at least 90 percent of the Project Area must consist of land within a single Assessment Area (as required in Section 4 of the FPP Versions 3.0 and 3.1).

3. **Where Necessary, Stratify Project Area Acres According to Whether They Are High or Low Site Class**

   The Assessment Area Data File on the Reserve's website provides data for each Assessment Area by high, low, or all site classes. For Assessment Areas where data are attributed for high and low site classes, Forest Owners must further stratify the Project Area and identify the acreage that falls within each site class.

   The computation of the statistics in the Assessment Area Data File (on a per acre basis) for board foot volume, basal area (square feet), and CO_2 equivalent was done for high and low site classes wherever the FIA plots were available in adequate quantity to achieve a sampling error of 18% or less. The board foot volume and basal area statistics are presented only to elucidate comparisons to the Common Practice (CO_2 equivalent) statistic. Board foot volume and basal area statistics are not used for other purposes in the protocol.

   For stratification purposes, a "high" site class means a Timber Site I or II (Forest Service Types I, II, and III). A low site class means a Timber Site III, IV, or V (Forest Service Types IV – VII). Landowners must determine the portion of the Project Area that is in each site class for each Assessment Area using soils data from a state or federal agency, direct site class data from a state or federal agency, attestation from a state

forester, or through field analysis. Whatever method is used, the Forest Owner must provide a description of the analysis to the verifier at the project's initial verification.

4. **Identify the Common Practice Statistic Associated with Each Assessment Area and Site Class Stratum**

   For each Assessment Area and Site Class within the Project Area, Forest Owners must identify the appropriate Common Practice statistic from Assessment Area Data File. The value displayed in the Assessment Area Data File indicates CO_2 equivalent metric tonnes per acre in the above ground portion (bole, bark, top and branches) of live trees.

   If data for an Assessment Area are provided for both high and low site classes, and a Forest Owner is unable or unwilling to stratify the Project Area into site classes using an acceptable method described above, then the high site-class Common Practice statistic must be used for all acres within the Assessment Area.

5. **Determine a Value for Common Practice for the Entire Project Area**
   The Forest Owner must determine a single Common Practice value for the entire Project Area by calculating the average of the Common Practice statistics for each Assessment Area and site class, weighted by the number of acres of each Assessment area and site class within the Project Area. See Table F.1 for an example.

Table F.1. Example of Common Practice Statistic Calculation

Ecosection /Supersection	Asessment Area	Site Class	Acres	Common Practice (Metric Tonnes CO_2-e)
Name the Ecosection/Supersection the project is found within.	*Identify the Assessment Areas the project is in.If the project is in more than one site class for an Assessment Area, enter the Assessment Area twice*	*Enter the Site Class Value*	*Acres for each Assessment Area-Site Class Combination*	*Enter the Value from the most current Assessment Area Data File*
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northeast Conifers	High	1,000	91.8
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northeast Conifers	Low	100	84.4
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northern Hardwood	High	50	102.8
Total Acres / Weighted Average Common Practice			**1,150**	**91.6**