

# **The Georgia Carbon Sequestration Registry**

## **Project Protocol**

**Version 1.0**

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**[www.gacarbon.org](http://www.gacarbon.org)**

## **Table of Contents**

<b>Section 1: Introduction</b>	<b>6</b>
1.1 Carbon Sequestration Overview	6
<b>Section 2: Program Overview and General Provisions</b>	<b>8</b>
2.1 Legal Basis and Administrative Authority	8
2.2 Registry Scope	8
2.3 Participant Eligibility	8
2.4 General Project Definition	8
2.5 Project Location Requirements	9
2.6 Qualified Project Types	9
2.7 Project Reporting	9
2.8 Project Reporting Deadlines	9
2.9 Project Quality Control, Monitoring, and Verification	9
2.10 Additional Terms and Conditions	10
<b>Section 3: Forest Project Eligibility Standards</b>	<b>11</b>
3.1 Section Purpose	11
3.2 Forest Project Definition	11
3.3 Forest Project Classifications	11
3.4 Restricted Forest Projects	12
3.5 Starting Year	12
3.6 Eligible Carbon Pools	13
3.7 Reporting Units	13
3.8 Native Tree Species	14
3.9 Best Management Practices	14
3.10 Forest Stewardship and Sustainable Forest Management	14
3.11 Eligibility of Federal, State, and Local Conservation Programs	14
3.12 Forest Project Reporting Deadlines	14
3.13 Approved Forester Requirement	14
<b>Section 4: Above-Ground Live Tree Biomass Carbon Estimation Protocols</b>	<b>16</b>
4.0 Section Purpose	16
4.1 Background	16
4.2 Protocol Overview	16
4.3 Carbon Sequestration Protocol for Timberland Owners with Reliable Inventory Information	17
4.4 Carbon Sequestration Protocol for Timberland Owners Without Reliable Inventory Information	19
4.5 Carbon Storage Tables for Major Timber Types in Georgia	22
4.6 Using the Carbon Storage Tables	23

<b>Section 5: Below-Ground Live Tree Biomass Carbon Estimation Protocols</b>	<b>24</b>
5.1 Background	24
5.2 Below Ground Root Biomass	24
5.3 Soil Carbon	25
<b>Section 6: Forest Products Carbon Protocols</b>	<b>27</b>
6.1 Background	27
6.2 Primary Wood Products Approach	27
6.3 Industrial Roundwood Approach	28
6.4 Forest Stand Approach	28
<b>Section 7: Forest Project Registration and Reporting Procedures</b>	<b>29</b>
7.0 Overview	29
7.1 Contact a Registry Approved Forester	29
7.2 Assemble Supporting Documentation	30
7.3 Establish Starting Report Year	30
7.4 Collect and Assemble Project Carbon Data	31
7.4.1 Forest Carbon Calculator	31
7.4.2 Direct Measurements	31
7.5 Apply for Registry Participant User Account	32
7.5.1 Participant Information	33
7.5.2 Forest Project Landowner Information	33
7.5.3 Forest Project Overview Information	33
7.5.4 Project Parcel Overview Information	34
7.5.5 GFC Review and User Account Creation	34
7.5.6 Login to Participant User Account	34
7.6 Register Forest Project Carbon Data	35
7.6.1 Project Parcel Classification (Default Tables)	35
7.6.2 Project Parcel Classification (Direct Measurements)	36
7.6.3 Approved Forester Sign-Off	37
7.6.4 Submit Parcel Map	37
7.6.5 Remit Project Filing Fee to GSCCCA	37
7.7 Annual Updates	37
7.8 Updating a Project Estimated Using Default Tables	38
7.8.1 Change Carbon Estimation Method	38
7.8.2 Report Thinning	39
7.8.3 Report Stand Disturbance	39
7.8.4 Report Change in Land Restriction	40
7.8.5 Report Change in Landownership	40
7.8.6 Report Change in Market Availability	41
7.9 Non-Standard Updates (Direct Measurement)	41
<b>Appendix A: Online Registry User Guide</b>	<b>42</b>
<b>Appendix B: Forest Carbon Estimation Tables</b>	<b>54</b>
<b>Appendix C: Examples and Illustrations</b>	<b>73</b>

## **Key Terms**

**Above-Ground Live Biomass (AGLB):** A required forest carbon pool; for the purposes of the Registry, carbon storage in the main stem of live trees located within a forest project.

**Approved Forester:** A forester registered in the state of Georgia who has completed training on the Registry and is approved by the Georgia Forestry Commission to develop and register forest projects.

**Below-Ground Live Biomass (BGLB):** A required forest carbon pool; for the purposes of the Registry, carbon stored in the coarse woody roots of live trees located within a forest project.

**Biomass:** The total sum of organic material in a given area or volume.

**Carbon Dioxide Equivalent (CO<sub>2</sub>e):** A measure, usually expressed in metric tons (MTCO<sub>2</sub>e), used to convert non-carbon dioxide greenhouse gas emissions to their CO<sub>2</sub> warming equivalents.

**Carbon Pool:** A clearly-identifiable reservoir of carbon.

**Carbon Sequestration:** The process of increasing the carbon content of one or more carbon pools other than the atmosphere. Examples of terrestrial carbon sequestration include afforestation, forest conservation, forest enrichment, and agricultural conservation practices

**Carbon Stocks:** The measured quantity of carbon stored in one or more carbon pools at a specified point in time.

**DBH:** Diameter at Breast Height, tree diameter at a stem height of 4.5 feet.

**Forest:** Land that is capable of supporting at least 10% tree canopy cover and that may be managed for one or more forest outputs; including, but not limited to: water quality, carbon sequestration, timber production, biodiversity, and aesthetics.

**Forest Offset:** Carbon sequestration and avoided CO<sub>2</sub> emissions achieved through forest management practices and afforestation that is used to mitigate GHG emissions caused by human activities.

**Forest Project:** Forest land managed to maintain existing carbon stocks, and remove additional carbon dioxide from the atmosphere and store it as carbon in one or more forest carbon pools for a specified period of time.

**Forest Soil Carbon:** Carbon held in the soil in organic matter, as humified material, and in stable structures, such as charcoal. An optional carbon pool; for the purposes of the Registry, carbon stored in the top 12 inches (30 cm) of soil within the boundaries of a forest project.

**Greenhouse Gases:** (GHG) The six gases identified in the Kyoto Protocol—Carbon Dioxide (CO<sub>2</sub>), Sulfur Hexafluoride (SF<sub>6</sub>), Nitrous Oxide (N<sub>2</sub>O), Methane (CH<sub>4</sub>), Perfluorocarbons (PFCs), and Hydrofluorocarbons (HFCs)

**Parcel:** A tract of land that is a component of a forest carbon sequestration project. Contains similar site conditions, species, and topographic conditions.

**Project Landowner:** The individual, entity, or organization owning the land occupied by a forest project.

**Registry Participant:** The individual, entity, or organization with the legal and contractual authority to register a forest project in the Registry. May or may not be the project landowner.

**Registry:** The Georgia Carbon Sequestration Registry. Administered by the Georgia Forestry Commission.

Roundwood: Unprocessed industrial raw wood material.

## Section 1: Introduction

This paper provides a comprehensive overview of the proposed methodologies, protocols, and mechanics of the Georgia Carbon Sequestration Registry ('the Registry').

### 1.1 Carbon Sequestration Overview

Carbon sequestration provides a low-cost, flexible way to mitigate greenhouse gas (GHG) emissions produced by the combustion of fossil fuels. As forests grow, trees absorb CO<sub>2</sub> from the atmosphere and trap (sequester) the carbon in the bole, roots, branches, and leaves. Globally, the amount of CO<sub>2</sub> in the atmosphere grows by 3 billion tons each year (Dangerfield 2004). An acre of managed southern pine forest can sequester between 1 and 4 tons of carbon per year, which is equivalent to 3.7—15.7 tons of CO<sub>2</sub> in the atmosphere.

The state legislature recognized this important forest value in 2004 when it authorized the Georgia Forestry Commission to develop the **Georgia Carbon Sequestration Registry**.

This voluntary program has four primary goals:

1. To encourage voluntary efforts to mitigate and reduce GHG emissions.
2. To provide new economic opportunities for Georgians.
3. To provide a legitimate, legal record of carbon sequestration.
4. To recognize registry participants' commitment to environmental stewardship.

Carbon sequestration is but one of many ecosystem services that forests provide to us. Other examples include clean water, habitat for wildlife, and erosion control. Although all of these services hold incredible value, they are not bought or sold in traditional economic markets and forestland owners are typically not paid for these outputs. In recent years, however, market-based approaches for reducing CO<sub>2</sub> emissions have garnered particular interest and landowners may soon be paid for the services their forests provide.

Many industries have made voluntary commitments to reduce their CO<sub>2</sub> emissions. Even in the absence of federal regulations that mandate GHG reductions, these entities are facing increasing pressure from shareholders and consumers to reduce their impact on the environment. For many CO<sub>2</sub> emitters, current capital investments inhibit sufficient reductions in emissions, so manufacturers and power plants purchase "carbon credits" from carbon sequestration projects to mitigate their GHG emissions.

In light of these current developments, Georgia's carbon registry will serve as a system for bringing CO<sub>2</sub> emissions-dependent companies together with terrestrial carbon sequestration projects. An online database will track and record carbon sequestration achieved from a variety of qualified forest practices. A few examples of qualified practices include tree planting, forest conservation, and forest ecosystem restoration. Companies interested in purchasing carbon offsets will use the Registry's database to find and evaluate listed projects.

The Georgia Forestry Commission welcomes all comments and questions. For additional information about the Georgia Carbon Registry, please contact:

**Josh Love**  
**Carbon Registry Manager**  
**Georgia Forestry Commission**  
**478-751-3482**  
**[joshl@gfc.state.ga.us](mailto:joshl@gfc.state.ga.us)**

## **Section 2: Program Overview and General Provisions**

### **2.1 Legal Basis and Administrative Authority**

The Georgia Carbon Sequestration Registry was established by the provisions of Senate Bill 356 in 2004. This legislative act provides for the creation of an official mechanism for the registration of eligible terrestrial carbon sequestration activities undertaken in the state of Georgia.

The Georgia Forestry Commission (GFC) is responsible for the implementation, administration, and oversight of the Registry. The Georgia Superior Clerks Cooperative Authority is responsible for the documentation of eligible projects in an online-accessible database.

### **2.2 Registry Scope**

The Registry serves as an official tool for the development, registration, documentation, and monitoring of eligible land-based carbon sequestration projects located in Georgia. Examples of projects that are currently considered (or will be considered in the future) include: land-use change, forest management activities, agricultural conservation practices, and other activities that facilitate carbon storage and accretion in terrestrial ecosystems. Program participation is voluntary and may be withdrawn at any time.

The Registry is not a mechanism for the reporting or regulation of entity/state-level greenhouse gas (GHG) emissions. This program is designed to facilitate the transfer of forest offset projects to current and future carbon markets and provide an official record for offset projects undertaken in the state of Georgia, but it is not a market platform for 'carbon credit' transactions, nor will the Registry purchase or sponsor carbon sequestration achieved by registered projects. The Registry will not administer financial transactions or enforce third-party contractual agreements.

### **2.3 Participant Eligibility**

All individuals, organizations, and entities that wish to establish a Registry-eligible carbon sequestration project on lands under their ownership/jurisdiction in the state of Georgia are eligible for participation. In addition, all individuals, organizations, and entities possessing the explicit legal authority to claim ownership of carbon accretion and storage on third-party lands may register eligible projects. Registry participants are not required to be residents of the state of Georgia.

### **2.4 General Project Definition**

A project is comprised of one or more parcels of land that have, as a primary management objective, the annual accretion and long-term storage of carbon in one or more carbon pool. For details on defining a forest project, see Section 3: Forest Project Eligibility Standards

## **2.5 Project Location Requirements**

Offset projects must be located within the geographical boundaries of the state of Georgia in order to be eligible for registration.

## **2.6 Qualified Project Types**

Currently, the Registry accepts only forest-based projects. In the future, the Registry will provide for additional project types to be reported. This may include carbon offset projects from agriculture, agroforestry, urban forestry, and other land management applications that support carbon sequestration. As cost-effective methods of quantifying carbon accretion and storage are developed, the Registry will maintain the flexibility necessary to incorporate these project types into the framework set forth in this protocol.

## **2.7 Project Reporting**

Participants will be required to complete a registration application for each project to be enrolled in the Registry. Applications may be made online by means of the Registry's online registration and reporting tool, or submitted in hard copy to the Georgia Forestry Commission. The registration application will include information on the participant, project parameters, site characteristics, location, and estimates of current and future carbon sequestration.

In each subsequent year of participation, an annual report shall be made for each project under a participant's authority. The annual project report will reflect the carbon sequestration activity that occurred within the project for the current report year. Harvest, thinning, and natural disturbances that decrease carbon storage on project lands will be reported for the report year in which it occurred. These reports may be made online or submitted in hard copy to the Georgia Forestry Commission.

Please refer to **Section 7: Forest Project Registration and Reporting Procedures** for complete details on reporting requirements.

## **2.8 Project Reporting Deadlines**

The reporting deadlines for registered projects are listed below:

*Initial project registration:* January 1 – December 31

*Project reporting year:* January 1 – December 31

*Update report deadline:* July 31 of the year following the report year.

For example, a project may report the carbon sequestration activity that occurred in 2007 between January 1 and July 31 of 2008.

## **2.9 Project Quality Control, Monitoring, and Verification**

The GFC is the primary agency responsible for the administration and oversight of the Registry and all participating projects. Registry participants and project landowners will agree to allow GFC personnel onto project lands for monitoring and verification of registered project activity following a reasonable notification period. All supporting documentation must be made available to GFC personnel for auditing purposes. These measures will help to ensure the integrity and transparency of the Registry.

In order to ensure the accuracy of carbon measurements reported to the Registry, all projects must be reviewed and endorsed by a Registry-approved forester who has received training in the Registry protocols. A current list of consulting foresters and GFC foresters approved for project registration is available online at [www.gacarbon.org](http://www.gacarbon.org).

## **2.10 Additional Terms and Conditions**

- (1) GCSR makes no warranty as to the marketability or market value of carbon accumulation achieved by registered projects
- (2) Participants agree to make a 'good faith' effort to adhere to the standards outlined in this protocol document for the duration of project enrollment.

## Section 3: Forest Project Eligibility Standards

### 3.0 Section Purpose

This section will detail the eligibility standards for forest-based projects, which include afforestation, reforestation, and forest management practices.

All qualifying carbon sequestration projects must meet the eligibility requirements described in this section. Projects proposed for participation in the Registry will be subject to the approval of the Georgia Forestry Commission. Additional standards (and refinements to established standards) may be added in future versions of the protocol.

### 3.1 Forest Project Definition

A forest *project* is defined as a collection of one or more parcels of forested land that have, as a primary management objective, the accretion and storage of carbon in one or more forest ecosystem carbon pools<sup>1</sup>.

A *project parcel* is defined as a single, contiguous tract of land that shares similar forest characteristics and site conditions.. Multiple parcels are not required to be contiguous with one another.

In addition, all parcels within a forest project must have the following characteristics in common:

- (1) All parcels within a project must be owned by the same individual, entity, or organization.
- (2) All parcels within a project must share the same project classification (afforestation or forest management).
- (3) All parcels within a project must register carbon stocks using the same carbon estimation method.
- (4) All parcels within a project must have the same land restriction classification (restricted or unrestricted.)

### 3.2 Forest Project Classifications

Currently, the Registry accepts two types of forest projects:

- (1) *Afforestation Project*. The planting of trees or the direct seeding of tree seeds on lands that were previously dedicated to non-forest uses for at least ten consecutive years prior to forest establishment. Examples of non-forest land-use include, but are not limited to: mining, row-crop agriculture, and forage. This project class is limited to tree establishment practices that result in properly-stocked native forests. Park projects, street/lawn trees, agroforestry practices, and other tree planting projects that result in low tree densities (i.e., “open grown” trees) are not currently eligible for registration. To

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<sup>1</sup> Eligible carbon pools are explained in section 3, page 12

qualify as an afforestation project, **all tree establishment project activities are required to have been initiated on or after January 1, 1990 on lands that were in non-forest land use for at least ten consecutive years.**

- (2) *Forest Management Project.* Land management practices on existing forest lands that provide for tree growth that facilitates carbon accretion and storage. This forest project type may include a wide variety of practices and silvicultural applications to a forest stand. Some examples include forest ecosystem restoration, timber stand improvement applications, and forest conservation.

### **3.3 Restricted Forest Projects**

Projects that are able to demonstrate that carbon stocks in forest project parcels will be subject to long-term maintenance will be noted by the Registry as “Restricted”. Forest projects undertaken on public/municipal/government-owned lands will qualify for restricted status without additional documentation.

Forest projects undertaken on private lands may qualify for restricted status by meeting ONE of the following requirements:

- (1) Establishment of a long-term easement containing provisions stating that project forest parcels will be maintained in forest cover for the entire duration of the easement.
- (2) Transfer of project forest parcels to a land trust, non-governmental organization (NGO), or governmental body that ensures that the project will be maintained in forest cover
- (3) Other methods deemed acceptable by the Georgia Forestry Commission

All eligible forest projects that do not meet any of the above standards will be classified as “Unrestricted”. The Registry will re-classify any Unrestricted Project as a Restricted Project, at any time during the project’s participation in the Registry, if one of the requirements listed above is met.

### **3.4 Forest Carbon Quantification Methods**

Forest projects may be quantify carbon stocks using a combination of direct measurements and computer models OR via default carbon accumulation tables provided by the Registry. Refer to Sections 4, 5, and 6.

### **3.5 Starting Year**

All projects must establish a starting year from which to begin tracking forest carbon stocks. Projects may use any year between 1990 and the current report year as the project starting year. If a year prior to the current report year is used as the starting year, estimates of carbon storage for all years between the starting year and the current report year must be available and will be reported to the Registry.

### 3.6 Eligible Carbon Pools

Forest ecosystems accumulate and store carbon in a variety of distinctive reservoirs, referred to as “carbon pools”. It is not necessary or economically feasible to measure all forest carbon pools within a forest stand. The measurement of one or more key carbon pools using established methodologies provides a conservative, yet robust estimation of carbon sequestration over a prescribed period of time.

At this time, the Registry will require all projects to report carbon storage in the merchantable wood of living trees (above-ground live biomass) and the coarse tree roots (below-ground live biomass) stored within the boundaries of the project.

Afforestation projects that are established on lands that were continuously cropped for at least ten years prior to forest establishment may report carbon storage in forest soils (Soil Organic Carbon, or SOC).

All projects may report carbon storage in forest products manufactured from timber removed from within the boundaries of the project. In the future, the Registry may develop protocols for reporting *only* forest product carbon storage. Refer to Sections 4, 5, and 6 for accepted methodologies for calculating and reporting Registry-accepted carbon pools. An overview of forest carbon pools is shown in Table 3.1.

**Table 3.1.** An overview of forest ecosystem carbon pools.

Carbon Pool	Definition	Reported to Registry?	Estimation Method
Above-Ground Live Biomass	Main Stem of living trees, merchantable height only.	Required	Default estimates or direct measurement
Below-Ground Live Biomass	Coarse woody tree roots	Required	25% of above-ground live biomass
Soil Organic Carbon	Non-mineral carbon stored in forest soils.	Optional. Only a subset of projects will be eligible to report soils.	Default Estimates
Forest Products	Carbon storage in forest products	Optional, but automatically computed if Above-Ground Live Biomass is estimated using default estimates.	Decay calculation from standard tables
Dead Standing biomass	Dead, standing trees (i.e. “snags”)	Not reported to Registry	n/a
Dead Down Biomass	Dead, fallen trees	Not reported to Registry	n/a
Shrubs and Herbaceous Understory	Living non-woody understory components	Not reported to Registry	n/a
Litter	O horizon (duff)	Not Reported to Registry	n/a

### 3.7 Reporting Units

Carbon stocks will be reported for all eligible pools (above ground, below ground, soils, and forest products) in short tons of carbon per acre. The Registry’s online database will automatically convert these values to metric tons of CO<sub>2</sub> equivalent.

### **3.8 Native Tree Species**

All eligible forest projects will be composed solely of tree species native to the state of Georgia and must be listed in the publication *Native Trees of Georgia* by G. Norman Bishop<sup>2</sup>.

### **3.9 Best Management Practices (BMPs)**

Forestry activities on registered project lands shall adhere to the standards set forth in the most current version of Georgia's Best Management Practices for Forestry as published by the Georgia Forestry Commission.<sup>3</sup>

### **3.10 Forest Stewardship and Sustainable Forest Management**

Forest projects must have a current Georgia Forest Stewardship plan or a forest management plan that meets or exceeds the standards of the Georgia Forest Stewardship program (agency signatures are not required). Management plans should include all of the following elements:

- (1) 10-year planning horizon.
- (2) Primary management objectives identified
- (3) Soils and topographic information with management limitations
- (4) Management considerations for rare, threatened and endangered species and archeological resources
- (5) Stands delineated on an aerial photo
- (6) Stand descriptions and timelines for management activities.

If you are uncertain if your management plan meets the standards of the Georgia Forest Stewardship Program, consult your local GFC forester.

### **3.11 Eligibility of Federal, State, and Local Conservation Programs**

Forest projects currently enrolled or previously enrolled in federal, state, or local conservation programs are eligible for registration provided that all other eligibility standards are met.

### **3.12 Forest Project Reporting Deadlines**

Participants may register eligible projects at any time. The Registry will track and record carbon sequestration activities annually and reflect the carbon stock changes on project lands between January 1 and December 31 of the report year. Carbon stocks for a report year will not be added to the registry until after the report year is complete. Projects will complete an annual update report for each subsequent report year, This report is due July 31 of the year following the report year and will reflect the carbon sequestration activities that took place during the report year.

### **3.13 Approved Forester Requirement**

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<sup>2</sup> This publication is available online at: [www.gfc.state.ga.us/Education/nativetrees.cfm](http://www.gfc.state.ga.us/Education/nativetrees.cfm)

<sup>3</sup> This publication is available online at: [www.gfc.state.ga.us/ForestManagement/BMPManual.cfm](http://www.gfc.state.ga.us/ForestManagement/BMPManual.cfm)

Participants are required to contact a registered forester approved by the Registry to assemble project data and register carbon stocks. Georgia Forestry Commission personnel are not eligible to report projects to the Registry, as this constitutes a conflict of interest. A list of approved foresters is available at the Registry's website and the GFC's website.

## **Section 4: Above-Ground Live Tree Biomass Carbon Estimation Protocols.**

(Prepared by B. Borders, 2006)

### **4.0 Section Purpose**

This section will articulate the accepted methodologies for quantifying above-ground live tree biomass (AGLB). These methods will only quantify carbon stocks in the main stem of the tree (merchantable height), resulting in a conservative estimate of above ground carbon storage and are based upon standard forest measurement techniques and appropriate growth and yield models.

Project carbon stocks may be estimated via appropriate Registry-generated default estimates for Georgia's forests or through a combination of direct measurements and computer modeling. Distinct methodologies are presented for each of the two accepted approaches. It is important to note that the same carbon estimation methodology will be applied to all parcels within a project.

### **4.1 Background**

As individual trees and stands of trees grow they sequester carbon within their main stem wood and bark as well as within branches, foliage and roots. Sequestration of carbon in main stem wood results in longer term sequestration of carbon than in main stem bark, branches, foliage and roots since main stem wood remains in place for long periods of time (decades) while other tree components sequester and release carbon on shorter intervals due to factors such as natural branch pruning/decomposition, foliage drops/decomposition, root decomposition, and other factors. Consequently, carbon sequestered within the main stem wood of trees is viewed as a potentially economically valuable commodity that may be of interest to those entities that are viewed as large contributors of carbon dioxide to the atmosphere (e.g. electrical generation utilities).

To help develop a reliable Carbon Registry of timberland owners in Georgia, it is necessary to establish a sound protocol for the estimation of current and expected future carbon levels for various timber types found within the state. Upon development of a Carbon Registry and a sound/objective protocol of sequestered carbon amounts, it will be possible for carbon exchanges/brokers to bring carbon buyers together with carbon sellers to help facilitate transactions that will benefit both parties.

Today, carbon is still a relatively low value commodity. Thus, the protocol used to estimate current and expected future amounts of carbon sequestered in timber stands must be low cost, as well as reliable and objective. The carbon estimation protocol outlined below should meet these criteria.

### **4.2 Carbon Estimation Protocol for Timber Types in Georgia**

Tree and stand growth rates, and hence carbon sequestration rates, vary by many factors such as: stand type, stand age, site productivity/quality, stand density, as well as silvicultural inputs/treatments. A great deal of scientific investigation into the inventory of and development

patterns for timber types found in Georgia has been carried out over the past 50 plus years. Two important results of this effort has been the creation of sampling protocols to determine current standing timber inventories and simulation models to project how these inventories will develop over time. Since, the amount of carbon sequestered in stem wood can be determined from estimates of stem wood volume, stem wood green weight and stem wood specific gravity, the procedures/tools developed for timber inventory estimation and growth simulation can be used to determine the amount of carbon sequestered in existing trees and how this amount will change as the trees and stands of trees grow through time. Thus, estimation of carbon sequestered in main stems of trees is a timber inventory/growth and yield exercise. Consequently, traditional inventory methods can be used to determine current standing inventories of stem wood carbon by timber product (e.g. pulpwood, sawtimber). Current inventory information can then be used as input to appropriate timber growth and yield models to make projections of the amount of carbon that will be sequestered in stem wood as the timber ages. Traditional timber inventories carried out by professional foresters often cost in excess of \$5 to \$10/acre, depending on the intensity of the sample as well as other factors. Consequently, when developing a protocol to estimate current carbon inventories in stem wood, it is not rational to believe that timberland owners who have not had timber inventories carried out on their timberlands for other purposes would pay this amount to sell a commodity of a relatively low value as carbon. However, some timberland owners in Georgia routinely inventory their timber stands and maintain current estimates of inventory using timber growth and yield models.

Clearly, in the context of timberland owners who may want to participate in selling sequestered carbon, there are two broad groups: 1) those without reliable timber inventory information and 2) those with reliable timber inventory information. Therefore, two separate protocols are outlined below – one for each group.

#### **4.3 Carbon Sequestration Protocol for Timberland Owners With Reliable Inventory Information**

To qualify for this category, stand level probability samples of standing timber inventory must be available for the forest project. These inventories are required to have been carried out by a registered forester no more than 10 years ago (if the stand has not been thinned or harvested during this period) or after the most recent harvest activity within the stand. Sampling intensity for these inventories must result in demonstrated sample precision of 10% allowable error or less for total volume or tons of stem wood and bark. It is likely that estimates of standing inventory available from such samples will be presented in green tons of wood and bark per acre as well as for the entire stand. These estimates must have been determined using an appropriate individual tree green weight prediction equation or using an appropriate conversion process if the inventory is presented in units other than tons of wood and bark. To determine number of tons of sequestered carbon in stem wood the following conversion process must be used to convert green tons of wood and bark to tons of carbon sequestered in stem wood:

1. Multiply green tons of wood and bark (pulpwood, sawtimber for pine, pulpwood and sawtimber for hardwood) by 0.9 to obtain an estimate of the number of green tons of wood only for each product

2. Multiply green tons of wood for a given product by the appropriate specific gravity (Table 4.1) of wood to obtain an estimate of the number of dry tons of wood.
3. Multiply the number of dry tons of wood for a given product by 0.5 to obtain an estimate of the number of tons of sequestered carbon.

**Example 4.1.** Converting green tons of wood and bark to short tons of carbon.

A 500 acre tract of longleaf pine and slash pine was determine to contain 50 green tons of standing timber per acre.

*To determine green tons of wood only, multiply green tons of wood and bark by 0.90.*

$$50 \text{ green tons (wood and bark)} * 0.9 = \mathbf{45 \text{ green tons (wood only)}}$$

*To determine dry tons of wood only, multiply green tons of wood only by the species specific gravity (SG)*

$$\text{Specific Gravity (SG) for slash pine and longleaf pine} = 0.54 \quad (\text{from Table X.X})$$

$$45 \text{ green tons (wood only)} * 0.54 = \mathbf{24.3 \text{ dry tons (wood only)}}$$

*To determine standing tons of carbon, multiply dry tons of wood only by 0.5.*

$$24.3 \text{ dry tons (wood only)} * 0.5 = 12.15 \text{ tons of Carbon}$$

Therefore, at the point of inventory, the stand contains approximately **12.2 tons of carbon per acre**

**Table 4.1** Specific gravity of wood for major species (or species groups) in Georgia.

Species/Species Group	Specific Gravity
Loblolly pine ( <i>Pinus taeda</i> L.)	0.47
Slash pine ( <i>Pinus elliottii</i> )	0.54
Longleaf pine ( <i>Pinus palustris</i> )	0.54
Other pines ( <i>Pinus</i> spp.)	0.46
Soft Hardwoods	0.46
Hard Hardwoods	0.58

The procedure outlined above will produce an estimate of the number of tons of sequestered carbon at the point of inventory. To determine the tons of sequestered carbon from the point of stand inventory forward, the inventory information should be used to enter the appropriate carbon table discussed and presented below (see **Carbon Sequestration Protocol for Timberland Owners Without Reliable Inventory Information—Section 4.4** and **Carbon Sequestration Tables for Major Timber Types in Georgia**). Alternatively, the inventory information can be entered into the SiMS\_2003 or SiMS\_2006 stand simulator. The simulator should be set to generate estimates of green tons of wood and bark by product (use product specifications presented in Table 4.2) together with product degrade percentages of 15% of chip-n-saw to pulpwood and 10% of sawtimber to pulpwood for pine products and 20% of sawtimber to pulpwood for hardwood products (this insures consistency with the **Carbon Sequestration Tables for Major Timber Types in Georgia**). The procedure outlined above for conversion of

green tons of wood and bark to tons of sequestered carbon, should be used to obtain the expected number of tons of sequestered carbon by product. To help insure reliable estimates of sequestered carbon using the SiMS\_2003 or SiMS\_2006 simulator, input information for simulations should include inventory information (as described above) as well as silvicultural history.

Projected estimates of standing tons of per acre carbon should be generated for 10 years from the starting report year.

**Table 4.2.** Products and product specifications used to generate estimates of stem wood carbon sequestered in pine and hardwood stands.

Stand Type	Product	Min DBH (in.)	Max DBH (in.)	Top Diameter (in.)
Pine products	Pulpwood	4.5	11.5	3
	Sawtimber	11.5	No max	6
Hardwood products	Pulpwood	4.5	13.5	5
	Sawtimber	13.6	No max	8

#### 4.4 Carbon Sequestration Protocol for Timberland Owners Without Reliable Inventory Information

If a landowner does not qualify to make use of an existing timber inventory the following protocol should be used to determine current standing tons of stem wood carbon by product. A registered forester must interview the land owner and perform an examination (no probability sample will be used) of the timber stand(s) in question to determine to the best of his/her ability the following information:

- Major species if pine stand
  - Loblolly (*Pinus taeda*, L.)
  - Slash (*Pinus elliottii*, Engelm)
  - Longleaf (*Pinus palustris*)
  - Other pine (*Pinus* spp.)
  
- Hardwood species group if hardwood stand
  - Upland Hardwood
    - Hard hardwoods
    - Soft hardwoods
  - Bottomland Hardwood
    - Hard hardwoods
    - Soft hardwoods
  
- Stand origin
  - Planted cutover woodland site
  - Planted agricultural field
  - Natural regeneration area

- Stand age
  - Closest single year age class for planted pine or hardwood stands
  - Closest five year age class for natural pine stands and natural pine-hardwood stands
  - Closest 10 year age class for hardwood stands
  
- Site quality (SI = base age 25 for planted stands, base age 50 for natural stands)
  - Planted Loblolly pine (cutover woodland stand)
    - Low –  $SI \leq 57'$
    - Medium –  $57' < SI \leq 67'$
    - High –  $SI > 67'$
  - Planted Slash pine (cutover woodland stand)
    - Low –  $SI \leq 53'$
    - Medium –  $53' < SI \leq 63'$
    - High –  $SI > 63'$
  - Planted Longleaf pine (cutover woodland stand)
    - Low –  $SI \leq 50'$
    - Medium –  $50' < SI \leq 60'$
    - High –  $SI > 60'$
  - Planted Other pine (cutover woodland stand)
    - Low –  $SI \leq 53'$
    - Medium –  $53' < SI \leq 63'$
    - High –  $SI > 63'$
  - Planted Loblolly pine (agricultural field)
    - Low –  $SI \leq 60'$
    - Medium –  $60' < SI \leq 70'$
    - High –  $SI > 70'$
  - Planted Slash pine (agricultural field)
    - Low –  $SI \leq 57'$
    - Medium –  $57' < SI \leq 67'$
    - High –  $SI > 67'$
  - Natural Loblolly pine
    - Low –  $SI \leq 70'$
    - Medium –  $70' < SI \leq 90'$
    - High –  $SI > 90'$
  - Natural Slash pine
    - Low –  $SI \leq 65'$
    - Medium –  $65' < SI \leq 85'$
    - High –  $SI > 85'$
  - Natural Longleaf pine
    - Low –  $SI \leq 55'$
    - Medium –  $55' < SI \leq 75'$
    - High –  $SI > 75'$
  - Natural Other pine
    - Low –  $SI \leq 65'$
    - Medium –  $65' < SI \leq 85'$

- High – SI > 85'
  - Upland Hardwood and Bottomland Hardwood
    - Low – SI ≤ 70'
    - High – SI > 70'
- Stand Density
  - Planted pine stands (cutover woodland and agricultural field)
    - Low – fewer than 575 trees/acre planted
    - High – more than 575 trees/acre planted
  - Natural pine stands
    - Loblolly, Slash and Other pine
      - Low – fewer than 600 trees/acre at age 10 years
      - High – more than 600 trees/acre at age 10 years
    - Longleaf pine
      - Low – fewer than 600 trees/acre at age 15 years
      - High – more than 600 trees/acre at age 15 years
  - Hardwood stands (Upland and Bottomland)
    - No density classes
- Thinning condition (an indication as to whether the stand is unthinned, thinned once or thinned more than once) (Pine stands only)
  - Unthinned (no obvious history of thinning)
  - Thinned once – stand has been thinned one time
    - Attempt to determine age at which thinning occurred
  - Thinned more than once – multiple thin operations have occurred
    - Attempt to determine ages at which thinnings occurred
- Management Intensity (Planted pine stands only)
  - Non-intensive management
    - No vegetation control with herbicide
    - No fertilization
  - Intensive management
    - Successful woody vegetation control at site preparation
    - Herbaceous weed control in year of planting
    - Fertilization following thinning operation(s)
- Level of genetic improvement (Planted loblolly and slash pine stands only)
  - Unimproved
  - First generation improved
  - Second generation improved
  - Unknown
    - stands established prior to 1986 were = unimproved
    - stands established between 1986 and 1999 = first generation
    - stands established after 1999 = second generation

Once the information for each criterion above is determined to the best of the registered forester's ability, the appropriate carbon table should be entered to obtain an estimate of current standing tons of carbon sequestered within stem wood. The expected future number of tons of carbon sequestered within stem wood can also be read out of the appropriate carbon table.

#### **4.5 Carbon Storage Tables for Major Timber Types in Georgia**

Carbon tables that present the amount of carbon sequestered within various types of wood products have been developed for the primary timber types found in Georgia. Tables 1 through 9 (Appendix I) present the number of tons of carbon sequestered within the stem wood of trees that will ultimately be sold for use as fiber or solid wood products. This will allow carbon buyers to differentially value sequestered stem wood carbon based on ultimate end use. All tables present the expected number of tons of sequestered carbon by product as well as stand age.

Each table starts with a header record that contains 8 descriptive items:

1. Species – Loblolly, Slash, Longleaf, Oak-Gum-Cypress, Oak-Hickory, Oak-Pine
2. Stand Origin – Natural, Planted, Planted Oldfield
3. Site Index (base age 50 for natural, base age 25 for planted) – Low or High for natural stands of pine (no difference for hardwood), Low, Med, or High for planted stands of pine, ALL for hardwood stands
4. Initial Density (age 10 trees/acre for natural pine (High, Low), no classes for hardwood, planting density for plantations (High, Low))
5. Level of management – Ext = extensive; Int = Intensive
6. Genetic Improvement – UI = unimproved (all natural pine and hardwood as well as plantation); in addition for plantations we have 1G and 2G (1<sup>st</sup> generation improvement and 2<sup>nd</sup> generation improvement – NOTE that plantation longleaf only has UI and 1G)
7. Physiographic Region – ALL used when we have no differences among regions (thus there is only a single all encompassing table); LCP – lower coastal plain; PID – piedmont/upper coastal plain
8. Harvest type – CC = carbon yields for a stand that has never received thinning; T22 = carbon yields for a stand that was thinned at age 22; T23 = carbon yields for a stand that was thinned at age 23, etc. Thus, users will have to know when and if their stand had been thinned – they will use the CC table for carbon yields prior to the thin; they will use the appropriate thin table after the thin (If the stand is multiple thinned – they simply need to pick the thin table closest in age to the most recent thinning operation)

The next record for each table contains column headings – Age, PWCarbon (pulpwood or fiber), STCarbon (sawtimber). It should be noted that hardwood carbon tables do not have estimates separated by product and the label is StemCarbon. Hardwood stand type carbon estimates come from Smith et al. (2006).

If stands are older than the oldest age given within a table the user would simply use the oldest age estimate provided (i.e. age 59 estimates for natural stands should be used for all age 59 and older natural stands).

#### **4.6 Using the Carbon Storage Tables for Major Timber Types in Georgia**

Once the information for each stand parameter is determined, the appropriate carbon storage table may be used to estimate historical, current and future carbon stocks in above ground live biomass. For each parcel, the stand examination data will be inputted into the Forest Carbon Calculator, which will provide per-acre estimates of AGLB carbon sorted by product class. It should be noted that hardwood parcels will not have estimates separated by product class. Estimates of AGLB carbon storage will be generated separately for each parcel within the project; parcel-level estimates will then be summed for project-level estimates.

*Note that the default tables do not reflect all combinations of the stand parameters listed above. If a particular forest stand cannot be accurately described using the available tables, contact the Registry for assistance.*

## **Section 5: Below-Ground Live Tree Biomass Carbon Estimation Protocols**

(Prepared by D. Markewitz, 2006)

### **5.1 Background**

Much of the carbon that is sequestered by trees ends up in the belowground environment. Belowground carbon includes coarse and fine roots, and soil carbon. Soil carbon is often considered to be organic carbon retained within mineral soil. Soil carbon, however, may also include the forest floor (i.e., the soil O horizon) and coarse woody debris (also referred to as lying woody debris or downed dead wood). In addition, many soils in Georgia, particularly in the lower coastal plain or flat woods, are organic soils (i.e., muck or peats in the Histosol order) or Spodosols, which possess accumulations of carbon at some subsurface depth.

In general, quantifying the amount of carbon belowground has proven difficult simply due to problems of sampling. Furthermore, quantifying changes in soil carbon pools has been challenging given the large background of carbon often already present. On the other hand, it is because of the large content of carbon belowground that there is interest in quantifying the role of these carbon pools in carbon sequestration.

Within the Georgia Carbon Sequestration Registry, participants will be allowed to register carbon stocks in belowground coarse roots and mineral soil organic carbon. For purposes of this registry, mineral soil will include soils typically referred to as organic (i.e., in the Histosol order) but will exclude organic carbon accumulations in the forest floor or coarse woody debris.

### **5.2 Belowground Root Biomass**

Belowground biomass is comprised of living plant tissues growing below the soil surface. These tissues consist of coarse and fine roots. Within the Georgia Registry it is the larger, long-lived coarse roots which will be incorporated into the carbon accounting scheme. Fine root biomass will not be accounted for directly but it is assumed some portion of fine root carbon sequestration may be incorporated into estimates of soil carbon sequestration.

Studies of tree growth physiology across a broad range of tree species on many sites indicate that there is a relatively constant relationship between above and belowground living tree biomass. This ratio of the above to belowground biomass (often referred to as the shoot to root ratio) is approximate 4:1 or, in other words, ~20% of total tree biomass is belowground (MacDicken 1997, McKenzie et al. 2000). As such, estimation of the carbon in belowground coarse roots biomass (including tap roots) is easily achieved by utilizing aboveground biomass protocols for merchantable volume and multiplying by 0.25. Given the fact that merchantable volume only accounts for a portion of total aboveground biomass this approach will also provide a relatively conservative estimate of total belowground biomass.

$$(1) \text{ Belowground coarse root biomass} = \text{Aboveground merchantable volume} * 0.25$$

Participants in the carbon registry will be expected to utilize the data they have generated under the aboveground accounting scheme for estimation of belowground coarse root biomass. As such, participants will be required to register aboveground carbon biomass before they can register belowground carbon biomass (see Section 7).

### *3.2.3 Verification:*

Participants registering belowground coarse root carbon sequestration will be required to follow verification procedures as outlined above for aboveground forest carbon sequestration. Utilizing these aboveground inventories, participants will utilize equation 1 to estimate the actual amount of belowground coarse root carbon biomass. No direct measures of belowground coarse root carbon biomass are required for verification.

## **5.3 Soil Carbon**

There continues to be much interest in the ability of forest soils to sequester carbon. This optimism is based on the relatively large amount of soil carbon that can be found in forest ecosystems and the fact that conversion of forest to agriculture typically generates large losses (~50%) of surface soil carbon that should theoretically be recovered during reforestation. Despite this optimism there is much uncertainty about the quantitative rate at which soil carbon can be sequestered under scenarios of afforestation or through forest management activities.

Regardless of uncertainties regarding the absolute rate of soil carbon accumulation, there is general agreement that carbon sequestration in soils is likely on sites planted to trees after 10 years or more of conventional agricultural activity. Similarly, there is general agreement that forest fertilization, which increase aboveground biomass production, will lead to increased soil carbon sequestration. Conversely, there are forest management activities such as prescribe fire, herbicide applications, or tillage that can decrease soil carbon, and soil carbon response to combined management activities such as fertilization in conjunction with herbicide application or prescribe fire are complex and difficult to predict.

Forest soil organic carbon is comprised of all organic carbon from the surface forest floor (the soil scientist's O horizon) through the mineral soils to bedrock (the soil scientist's A, E, B, and C horizon). For the purposes of this registry, inorganic soil carbon pools are not being considered and typically are not expected to sequester atmospheric CO<sub>2</sub>. Similarly, although forest floor organic carbon can accumulate during afforestation or accumulate at an accelerated rate through forest management, this pool is thought to be ephemeral and will not be considered for the purposes of the Georgia Carbon Sequestration Registry.

Mineral soil organic carbon will be considered for the Registry. Mineral soil organic C is often one of the largest pools of carbon in forested ecosystems. Unfortunately, the rate of carbon accumulation in mineral soil can be quite slow and it is this accumulation (or sequestration) that is of interest for participants of the registry. Furthermore, although soil carbon is present throughout the soil profile convincing evidence of accumulation has largely been demonstrated in the upper soil layers (i.e., 12 inches or 30 cm). As such, registration of soil carbon sequestration will only be considered for the upper 12 inches (30 cm) of mineral soil.

Land owners that are afforesting fields that have spent >10 yrs in conventional agricultural activities can use the following look-up tables to register soil carbon sequestration. To utilize these tables a land owner would look up the appropriate stand type and age for the stand of interest and multiply the annual rate by the chosen number of years. For example, if a landowner has a 5-year-old loblolly pine plantation for which they want to estimate the potential accumulation through age 15 they would utilize Table 2.3.1. For the above example they would utilize the 0-5 age rate for 1 year (i.e., 5 to 6 yrs), the 6-10 rate for 5 yrs and the 11-15 rate for 5 years.

$$\text{Estimated soil organic carbon sequestration per acre from age 5 to 15=} \\ (1 \text{ yr} \times 0.02 \text{ tonnes C/ac}) + (5 \text{ yr} \times 0.04 \text{ t-C/ac}) + (5 \text{ yr} \times 0.08 \text{ t-C/ac}) = 0.62 \text{ t-C/ac}$$

A landowner would then multiply this rate by the number of acres of afforesting pine present on their land. To utilize this approach land owners need to demonstrate at least 10 yrs of consecutive agriculture activity on any acres considered for afforestation (e.g., tax records, aerial photography) and must demonstrate the existence of the appropriate forest types. No modification to the tables are allowed.

Annual accumulation tables are found in Appendix B of this document.

## **6.0 Forest Products Carbon Protocols**

(Prepared by Dr. Jacek Siry)

### **6.1 Background**

Manufactured wood products are of major value for carbon sequestration in Georgia and the Southern United States. Currently, southern forests supply about 18% of the world's industrial roundwood, 14% of lumber, and 25% of wood pulp. Georgia and Alabama are the leading producers; Georgia alone produces as much pulp and paper products as does Finland or Sweden. Solidwood products are used primarily for residential construction, which have a long life-span. While pulp and paper products have shorter life-spans, high recycling rates (particularly for old corrugated containers, white office paper, and newsprint) as well as large volumes make them a potential source of carbon storage benefits. Further, when placed in landfills the time it takes to decompose paper products is very long. Because Georgia is a major producer and large amounts of carbon are stored in wood products, it is important to assess the quantity and duration of carbon stored in wood products.

Three approaches were adopted for assessing carbon stored in post-harvest sinks. The primary wood products approach allocates carbon stored in products to various end uses—it should be used by wood products manufacturers. The industrial roundwood harvest approach assesses the actual harvest and allocates it to various primary wood products and then end-use categories—it should be used by landowners selling their trees or by wood buyers. The forest stand approach allocates standing timber to product classes, then the wood harvest is allocated to primary wood products and end uses—it can be used to obtain estimates of carbon credits that may be potentially available should the harvest actually occur. Carbon storage in post-harvest sinks begins at the time of harvest. Over time, carbon stored in various end uses is depreciated along product- and use-specific depreciation schedules up to 100 years.

These approaches to the estimation of carbon sequestered in wood products and data tables were taken from Smith et al. (2006). This source should be referred to for more detailed background information and examples of how to estimate carbon storage in wood products.

### **6.2 Primary Wood Products Approach**

Harvested industrial roundwood is manufactured into primary wood products such as lumber, pulp, panels, etc. These products are then converted into end-use products such as housing or newspaper. In turn, these end-use products, after their useful life ends, can be recycled or disposed, including storage in landfills and burning.

The first step in estimating the amount of carbon sequestered in wood products involves the estimation of how much carbon these products contain. Table 1 in Appendix II provides appropriate conversion factors allowing estimation of how much carbon is stored in wood products. Then disposition schedules are used to assess carbon storage after a given number of years, including wood products in use and in landfills. These two sources represent carbon that is still sequestered in wood products at a given number of years following harvest or production

(assuming that harvest and production take place the same year). These numbers represent national averages and account for recycling.

In particular, Tables 2 and 3 (Appendix B) identify the shares of primary wood products in use and in landfill for up to 100 years that still remain in use or are disposed in a landfill. The major products include softwood and hardwood lumber, softwood plywood, oriented strand board, non-structural panels, miscellaneous products, and paper.

### **6.3 Industrial Roundwood Approach**

This approach starts with the volume of industrial roundwood harvested. This category excludes bark and fuelwood. The mass of carbon is estimated from the harvest volume along the procedures outlined in Sections 2.3 and 2.4. Once the mass of carbon in industrial roundwood harvested and removed from the forest is known, carbon disposition schedules are used to assess the storage of carbon in wood products after a given number of years. Table 4 (Appendix II) provides average disposition rates for the Southeast. It includes two products (sawlog and pulpwood) and two species groups (softwood and hardwood). The disposition schedules are provided for products in use, disposed in landfills, used for energy, and emitted without energy capture for up to 100 years.

This approach is better suited for landowners who sell their timber but would like to retain their carbon rights. They will have to document how much industrial roundwood was removed by product and species in order to develop carbon storage estimates in wood products.

Both approaches, the primary wood products and industrial roundwood, should provide the same estimate of carbon storage in wood products.

### **6.4 Forest Stand Approach**

Finally, it is possible to estimate the mass of carbon that would be stored in wood products if a forest stand were harvested at a given age. Approaches developed to forest carbon estimation stored in trees, developed in Sections 2.3 and 2.4, provide the distribution of carbon by product within merchantable volume. From there, industrial roundwood harvest estimates by product can be developed to assess carbon storage in wood products. They can be used to obtain estimates of carbon credits that may be potentially available should the harvest actually occur. However, carbon storage in wood products cannot be registered until the actual harvest takes place.

## **Section 7: Forest Project Registration and Reporting Procedures**

### **7.0 Section Overview**

This section articulates the details of the forest project registration and reporting procedures. Before beginning the registration process, it is suggested that you read this protocol in its entirety.

The procedures necessary to develop, register, and maintain a forest project in the Registry can be summarized in the follow steps:

1. Contact a Registry-approved forester.
2. Develop and delineate a forest project.
3. Collect and assemble project carbon stock data.
4. Apply online for a Registry participant user account.
5. Register forest project carbon data using the Registry online reporting tool.
6. Submit other materials, if required.

After successfully registering a forest project, you will need to complete the following steps periodically in order to maintain your project in the Registry:

1. Complete annual reports updating the status of your forest project.
2. Maintain management that supports carbon sequestration activity.
3. Report significant decreases in carbon stocks on project lands.

The remainder of this section will outline this process in detail. For additional information on using the Registry's online reporting software, refer to **Appendix A: Registry Website User's Guide**.

### **7.1 Contact a Registry-approved Forester**

In order to register a forest project in the Registry, an approved registered forester must be contracted to assemble and evaluate all relevant forest data. A list of registered foresters who are approved to register forest projects is available at the Registry website at [www.gacarbon.org](http://www.gacarbon.org).

GFC foresters are not eligible to register forest projects, as this is a conflict of interest.

## **7.2 Assemble supporting documentation**

All forest projects must compile the following supporting documentation (as applicable and relevant to the project). Registry participants should maintain this information on file and make it available for review by the Georgia Forestry Commission. Although you are not required to submit all of this information to the Registry, well-documented forest projects will be better-prepared for current and future carbon markets.

- 1) Project Site Information:
  - a) Location Information, including:
    - i) County (or counties)
    - ii) Deed book and page number for each county within the project parcel.
    - iii) Latitude and Longitude of approximate center of each parcel.
  - b) Map or Aerial photograph indicating scale that clearly delineates project boundaries and all project parcels. Any unique or sensitive areas within the project should also be clearly indicated on the map.
  - c) Site Index for each project parcel
  - d) Timber Types in each parcel
  - e) Soils data, including soil series, physical properties and management limitations.
  - f) Dominant landform(s) within each project stratum (e.g., bottomland, upland)
  - g) General aspect of each project parcel
- 2) Land management history:
  - a) Stand establishment year.
  - b) Pre-project land-use history, including practices and respective years.
  - c) Site preparation methods
  - d) Species planted and genetic improvement of planting stock
  - e) Trees per acre (TPA) at planting and tree spacing.
  - f) Survival surveys
  - g) Silvicultural activities with accompanying dates, residual stocking levels, etc.
  - h) All relevant data compiled from stand exams and/or inventories
  - i) Proof of open land prior to afforestation. (e.g., aerial photos, tax records, nursery receipts, CRP contract)
- 3) Forest stewardship/sustainable management:
  - a) Appropriate documentation for all forest sustainability certifications
  - b) Forest management plan that meets or exceeds the standards of the Georgia Forest Stewardship Program.
- 4) Evidence supporting “Restricted” project status, if applicable.

## **7.3 Establish a starting project report year**

In order to register a project’s carbon stocks, a project starting year must be determined. The starting year will constitute the first year for which carbon stocks are reported and will establish a baseline from which to track future carbon sequestration activities. At this time, it is unclear if

historical accumulations of carbon will be of any value in environmental markets. The earliest eligible start year is 1990. The latest starting year is the current report.

**Example 7.1.** Establishing a Starting Report Year for a Forest Management Project.

An inventory was conducted on a forest management project in 2005. For simplicity, the approved forester and the Registry participant decide to establish 2005 as the starting report year because it provides the most accurate starting point to begin tracking carbon storage in the project, since statistically-based estimates are available for that year.

**Example 7.2.** Establishing a starting report year for an afforestation project.

An afforestation project was planted in 2000. Since the project land was not forested prior to tree establishment, the approved forester and the Registry participant decide to establish 2000 as the starting report year. The carbon stocks of the stand at the starting report year is 0 tons C / ac, and the stand age for the starting report year is 0 years.

## **7.4 Collect and Assemble Project Carbon Data**

Using one of the two accepted methodologies described in Section 4, projects will estimate per-acre above-ground live tree biomass (AGLB) for the starting report year and all subsequent years up to, and including, the current report year. In addition, projects will provide future estimates of per-acre carbon storage for the next ten report years. Carbon data should be collected prior to beginning the registration process.

The data necessary to provide historical, current, and future projections of carbon storage will depend upon the forest carbon estimation approach that is used and therefore each carbon estimation methodology is addressed individually.

### **7.4.1 Forest Carbon Calculator**

The default carbon accumulation tables are incorporated into an online Forest Carbon Calculator that will automatically generate the appropriate estimates of carbon storage in above ground, below ground, and forest soils based upon particular forest parameters outlined in Section 4.

In order to use the Registry's forest carbon calculator, you will need stand exam information for each forest project parcel. You must also establish a starting year and associated age from which to begin reporting AGLB carbon. The 1990 report year is the earliest eligible starting year.

### **7.4.2 Direct Measurement Method**

If you choose to estimate AGLB carbon in your project using a combination of direct measurements and growth models, the following carbon data should be prepared and organized for each parcel:

1. Starting report year and associated parcel age at starting report year. The year the eligible inventory was conducted will constitute the earliest eligible starting report year.
2. Estimates of tons per-acre above-ground carbon storage sorted by product class (pulpwood and sawtimber) for the starting year, the current year, and all report years in between. For each report year, indicate whether a direct measurement or computer models were used to generate the estimate.
3. 10-year projections of tons per-acre AGLB carbon storage sorted by product class (pulpwood and sawtimber) as estimated by approved computer models.

Once the AGLB carbon data is collected, the information necessary to register your project is complete. Before registering the project, however, it is necessary to apply for a Registry participant user account.

### **7.5 Apply for a Registry Participant User-Account**

As the participant, you are responsible for registration, reporting, and updating your project with the assistance of a Registry-approved forester.

Prior to registering a forest project, you must first establish a Registry user account that will provide you with access to the Registry's online reporting tool. Access the Registry's Internet homepage at [www.gacarbon.org](http://www.gacarbon.org) and click the "apply online" link to create your user account. Once you are issued a participant user account, you will be able to register new projects, provide annual updates on existing projects, and track your project's carbon stocks. It is important to note that you will be unable to register projects until a user account is created. The remainder of this section will review the information you will need to have available to successfully create a participant user account.

In addition to participant information you will also be asked to provide some overview information for the first project you plan to register.

### **7.5.1 Participant Information**

Participants may be private individuals or legally-constituted entities. The information below will be provided. New users will also create a username and password so they can access their account.

1. Full Name or Entity Name
2. Address
3. Contact Person
4. Phone Number
5. Fax Number
6. E-mail address

### **7.5.2 Forest Project Landowner Information**

Participants may own the “carbon rights” to a forest project without holding land title or other land-use rights. Under circumstances where the participant does not own the project lands, the following information is required regarding the land title holder:

1. Full Name
2. Address
3. Phone
4. Fax (*if applicable*)
5. E-mail. (*If applicable*)

If the participant is also the project land-title holder, it is not necessary to re-input this information. Simply click the box indicating this in the online application.

### **7.5.3 Forest Project Overview Information**

Once you have inputted the participant and forest project land title holder information, you will provide background information on the project you wish to register:

1. Project Name. *Provide a name for your project.*
2. Project Type. *Choose afforestation or forest management.*
3. Restriction. *Classify your project as “Restricted” or “Unrestricted”. (Section 3)*
4. Number of Project Parcels. *Enter the number of parcels within the forest project.*
5. Carbon Estimation Method. *All parcels must be quantified using the same method.*
6. Project Purpose. *Indicate the primary management objectives for the project. Check all that apply.*
7. Forest Certifications. *Check all that apply to the project.*
8. Market Availability. *Choose “yes” if you wish to make your project available to offset buyers.*

#### 7.5.4 Project Parcel Overview Information

To complete your application, you will need to input the following information for each forest project parcel.

1. Latitude and Longitude of approximate parcel center. *Input degrees, minutes, and seconds in the appropriate boxes.*
2. Number of counties within project. *Indicate how many counties the parcel is located in.*
3. Parcel County or Counties. *Using the drop-down menu, choose the appropriate counties. Include all counties within parcel.*
4. Parcel acres and tenths of acres in EACH county. *Indicate the parcel acreage located in each county.*
5. Deed book number for EACH parcel county. *Required for all project lands.*
6. Deed book page for EACH parcel county. *Required for all project lands.*

After inputting the information described above, you will be able to review your application for accuracy and completeness. To complete the user account application process, you will have the option of submitting your application online or printing it out and mailing it the Georgia Forestry Commission.

Mail your application to:  
Georgia Forestry Commission  
Attn: Georgia Carbon Registry  
P.O. Box 819  
Macon, GA 31202

#### 7.5.5 GFC Review and User-Account Creation

Registry personnel will review your user account application for completeness and accuracy. Registry staff may contact you with questions regarding your project. Once approved, you will be notified that your user account has been activated. You may now register project carbon data using the online reporting tool.

#### 7.5.6 Log-in to your user account

*Complete the following steps to access your user account:*

- (1) Access the Registry Internet homepage at [www.gacarbon.org](http://www.gacarbon.org) and click **Login to Your Account**.
- (2) Type your participant **username** and **password** into the appropriate boxes and click **Login**.

Successful login will take you to the participant start page for your account. From here, you will be able to register your project, update previously-registered projects, change your username and password, and update your personal information.

## 7.6 Register Forest Project Carbon Data

The participant start page displays your project's status. Although a record for your new project has been created, it will not be registered until forest carbon data is inputted for all parcels in the project. This section will describe the actions necessary to report forest carbon data and complete the registration process. The reporting procedure will differ depending upon the forest carbon estimation method used; therefore, separate reporting procedures are presented for each method.

### 7.6.1 Project Parcel Classification (Default Tables)

For reference purposes, an Microsoft Excel file is available at the Registry website that lists all available default carbon accumulation tables.

- (1) Access your Participant Start Page as described in **Section 7.5.7**.
- (2) To report the forest carbon data for your new project, click **Classify**. A list of each parcel within the project is presented on a new page.
- (3) Select the first parcel listed and click **Classify**. The forest carbon calculator form will appear below the parcel listing.
- (4) Select a starting report year and input the associated parcel age for that year.
- (5) Using the stand examination data for the parcel, select the appropriate forest classification from the drop down boxes provided (**Table 7.1**).

**Table 7.1.** Nine forest stand parameters used to estimate above-ground live biomass.

<b>Forest Classification (from stand exam)</b>	<b>Description/Instructions</b>
Species	Loblolly, Slash, Longleaf, Oak-Gum-Cypress, Oak-Hickory, Oak-Pine
Stand Origin	Natural, Planted, Planted Oldfield
Site Index <i>base age 50 for natural, base age 25 for planted</i>	Low or High for natural PINE stands Low, Medium, High for planted PINE stands All for hardwood stands (no difference)
Initial Density	Age 10 trees/ac for natural PINE stands Initial planting density for planted PINE stands All for Hardwoods
Level of Management	Extensive or Intensive
Genetic Improvement	Natural Pine and Hardwoods are Unimproved Unimproved, First Gen. or Second Gen. for PINE plantations
Physiographic Region	Lower Coastal Plain, Upper Coastal Plain for planted Loblolly All (no difference) for all other stands
Thinning Condition	Never thinned or Age at thinning (years) for PINES Never thinned for Hardwoods
Age	Years

- (6) If your project is eligible to report forest soil carbon (**Section 5**), check the box indicating this. The reporting software will automatically generate the appropriate annual estimates of forest soil carbon.
- (7) Based upon the provided information, the carbon calculator will compute annual estimates of carbon storage for all eligible pools for the starting report year and all subsequent years including the current report year. In addition, the software will generate annual estimates of forest carbon for 10 years into the future.
- (8) Approved forester confirms accuracy of the data submitted and authorizes the registration. (**Section 8.x.x**)

Repeat steps (3) through (7) for all parcels.

### 7.6.2 Project Parcel Classification (Direct Measurements)

Access your Participant Start Page as described in **Section 7.5.7**.

To report the forest carbon data for your new project, click **Classify**. A list of all parcels within the project are listed on a new page. I

Select the first parcel listed and click **Classify**. You will be prompted to enter inventory information corresponding to the parcel (**Table 7.2**).

**Table 7.2.** Forest inventory information reported to the Registry.

<b>Data Element</b>	<b>Description/Instructions</b>
Inventory Date	month and year inventory was conducted
Parcel age on Inventory Date	Parcel age at the year of inventory
Start Year	The first report year from which you will report forest carbon stocks. Must be current report year or earlier.
Major Species	Major species, or species communities (i.e. timber type)
Trees per Acre	Tree stems per acre, as determined by inventory
Site Index	Site index, as determined by inventory. Assume base age 50 for natural stands, base age 25 for planted stands
Basal Area	square feet per acre

Input the requested forest inventory information and click **Growth Projections**. Based upon your chosen start year and start age, the Registry will generate a reporting form for you to manually input forest soils, pulpwood carbon, and sawtimber carbon estimations for the start year and subsequent years—including the current report year and 10-year annual projections of future per-acre carbon stocks. Only afforestation projects established on agriculture lands are eligible to report soils. Report forest soils in tons of carbon per acre using the appropriate table as

provided in Section 5. Report Pulpwood and Sawtimber in short tons of carbon—the Registry will automatically convert these estimates to MTCO<sub>2e</sub>.

### **7.6.3 Approved Forester Sign-off**

Regardless of which forest carbon estimation method is employed, before each project parcel can be registered, an approved Forester must confirm the accuracy of all the information provided to the Registry. An approved forester will input his username and password to verify the forest carbon information. Project forest carbon data cannot be submitted or saved to the Registry without Forester verification.

### **7.6.4 Submit parcel map**

A map of each project parcel must be submitted to the Registry. You may submit it online (GIS shapefile, pdf, or other electronic format) or mail it to: **Make sure each parcel is clearly labeled with the parcel ID number assigned by the Registry and include the Project ID number.**

### **7.6.5 Remit Project Filing Fee to the GSCCCA**

A one-time project registration fee is required for registration has been determined by the Georgia Superior Clerks of Court Cooperative Authority and is based upon project size (in acres). The fee scale is as follows:

Less than 500 acres:	\$100
500 to 5000 acres:	\$250
Over 5000 acres:	\$500

## **7.7 Annual Updates**

In order to maintain a project registration, an update report must be filed each year that reflects all activities that occurred during the report year. Update reports shall be made between January 1<sup>st</sup> and July 31<sup>st</sup> of the year subsequent to the current report year (e.g., update for 2007 report year must be made between January and July of 2008).

Projects that are not updated by the deadline shall be flagged and temporarily removed from the Registry until an appropriate update is completed.

### **7.7.1 Standard Update Report (All Estimation Methods)**

A **standard update** report for each project parcel should be filed UNLESS one or more of the following activities occurred during the report year:

- The project experienced significant decreases in carbon stocks as a result of thinning, harvest, natural disturbance.
- Change in land ownership resulting in a decrease in project size.

- The participant wishes to report direct measurement data for a project that was previously estimated using default methods.

If any of the above activities occurred during the current report year, a **non-standard update** is required. See the sections 7.8 through 7.9 below for types of non-standard updates available.

The standard update serves as an attestation by the participant that the project continues to sequester carbon as outlined in the original registration. Once a standard update is filed, estimates of carbon stocks for the report year will be registered. **Approved forester sign-off is NOT required.** To perform a standard update, the participant should complete the following steps:

- (1) Access your participant user account start page.
- (2) Select a project and click **Update**
- (3) Select the first project parcel and click **Update**. A review of the parcel carbon activity is displayed.
- (4) Click **Standard Update**. You will be asked to confirm your standard update for the selected parcel.
- (5) Click **Confirm Update**. The parcel is now updated for the current report year and the estimated carbon stocks will be registered.
- (6) Repeat steps (2) through (5) for all project parcels.

NOTE: A standard update does not allow the participant to change any forest carbon data for previous, current, or future report years.

## **7.8 Updating a project estimated using Default Carbon Accumulation Tables.**

### **7.8.1 Change Carbon Estimation Method**

Project forest carbon stocks originally estimated using the Registry's forest carbon calculator (default method) may re-estimate carbon stocks using the direct measurement method if a forest inventory of the parcel was conducted during the report year. Projects originally estimated using the direct measurement method are not eligible to switch to the default method. To change a project parcel's carbon estimation method, complete the following steps:

- (1) Access your participant user account start page
- (2) Select a project and click **Update**.
- (3) Select the first project parcel and click **Update**. A review of the parcel carbon activity is displayed.
- (4) Click **Switch to Forest Inventory Method**. To confirm the change, an approved forester username and password is required.
- (5) Click **Save Changes**. You will be redirected to a new update page.
- (6) On the new update page, click **Update with Changes**. A new form will appear for your approved forester to manually enter the forest carbon data as determined by the new inventory.

- (7) In addition to reporting carbon stocks for the current report year, it will be necessary to report 10-year projections of future carbon stocks. Projects may not change data for previously-reported years.

The newly reported forest carbon data will be compared to the original default estimates generated for previous report years.

### 7.8.2 Report Thinning

The default tables have been designed to incorporate thinning activities into forest carbon estimation. If a parcel is thinned during a report year, a non-standard update is required. The forest carbon calculator will automatically generate estimates of residual carbon stocks. Forest carbon removals will be converted using the industrial roundwood methodology described in Section 6 and transferred to the parcel's forest product carbon pool. To complete report a thinning, complete the following steps:

- (1) Access your participant user account start page.
- (2) Select a project and click **Update**.
- (3) Select the first project parcel and click **Update**. A review of the parcel carbon activity is displayed.
- (4) Select **Update with Changes**. The Registry will provide several update options for the parcel.
- (5) Select **Report Year Thin**.
- (6) The forest carbon calculator will re-estimate your carbon stocks and provide new 10 year projections of annual carbon accumulation. A percentage of the carbon removals will be transferred to the forest carbon pool automatically based product class and species. Removals that are not transferred to the forest product pool will be represented as emissions. Below-Ground Live Biomass will also be adjusted based upon the new estimates of Above-Ground Live Biomass.
- (7) The forester will validate the update by entering his/her username and password.
- (8) For the remaining parcels, repeat the update process using the appropriate update option.

### 7.8.3 Report Stand Disturbance

The default forest carbon estimation method relies upon specific forest stand parameters. If a parcel is harvested or carbon stocks are reduced due to natural disturbance, these parameters will no longer accurately reflect the affected project parcel. Therefore, if any such decrease occurred during the report year, the update report must reflect the acres that were affected by the disturbance. Those acres that are removed from the parcel may be re-registered as a new project parcel using an appropriate default table. To report a disturbance, complete the following steps:

- (1) Access your participant user account start page.
- (2) Select a project and click **Update**.
- (3) Select the first project parcel and click **Update**. A review of the parcel carbon activity is displayed.

- (4) Select **Update with Changes**. The Registry will provide several update options for the parcel.
- (5) Select **Report Disturbance**. The Registry will generate the appropriate reporting form.
- (6) Use the drop down menu to select the type of disturbance.
- (7) Use the provided text box to provide more detail regarding the disturbance.
- (8) If any of the carbon stock decrease is transferred to the forest products pool, input these values into the appropriate cells.
- (9) Input the number of acres and tenths of acres effected by the disturbance that are no longer accurately reflected by the current carbon table for each county within the parcel.

The Registry will automatically re-calculate the forest parcel carbon stocks for all eligible pools. The acreage effected by the disturbance may be re-registered as a new project using the appropriate default table.

#### **7.8.4 Report Change in Project Land Restriction**

To change the land restriction for a project parcel, complete the following steps:

- (1) Access your participant user account start page.
- (2) Select a project and click **Update**.
- (3) Select the first project parcel and click **Update**. A review of the parcel carbon activity is displayed.
- (4) Select **Update with Changes**. The Registry will provide several update options for the parcel.
- (5) Select **Change Restriction Status**.
- (6) Approved forester sign-off on the change in land restriction.

#### **7.8.5 Report Change in Landownership**

If a portion or all of a project parcel was transferred, sold, or otherwise legally-disconnected from the project during the current report year, complete the following steps to report this to the Registry:

- (1) Access your participant user account start page.
- (2) Select the project and click **Update**.
- (3) Select the first parcel associated with change in landownership and click **Update with Changes**.
- (4) Select **Change in Ownership**. A reporting form will appear at the bottom of the screen.
- (5) Input the acres for each county in the project parcel that were transferred.
- (6) Have an approved forester sign-off on the accuracy of the updated information.
- (7) Repeat steps (2) through (6) for all parcels where land ownership changed during the report year.

The Registry will automatically re-calculate the project based upon the new acreage in each parcel.

### 7.8.6 Report Change in Market Availability

To change the market availability of a project, complete the following steps:

- (1) Access your participant user account start page.
- (2) Select the project and click **Update**.
- (3) Select the first parcel associated with change in landownership and click **Update with Changes**.
- (4) Select **Change in Market Availability**.
- (5) Select **Available** or **Unavailable**.

### 7.9 Non-Standard Update (Direct Measurements)

If your project is estimated using a combination of direct measurements and computer models, your forester will be required to manually input any modifications of registered carbon estimates for the report year. A non-standard update should be completed if any of the following activities occurred during the report year:

- The project parcel was thinned.
- The project parcel was harvested.
- The project parcel experienced a natural disturbance
- A new inventory was conducted.
- Any other activity that modified the forest carbon estimate provided for the report year in the original registration.

Forest projects that are estimated using direct measurements and computer models are required to report actual decreases in forest carbon stocks. In order to accurately estimate any decrease in forest carbon stocks, the following information will be reported to the Registry:

- (1) PER-ACRE Residual Above-Ground Live Biomass, organized by product class, for the report year. Indicate in the comments box how this estimate was generated.
- (2) Revised PER-ACRE projections of Above-Ground live Biomass, organized by product class. Indicate in the comments box how these annual estimates were generated.
- (3) PER-ACRE Forest Product Carbon for current year and future report years, using the methodologies described in Section 7. If removals are not utilized for forest products, no values will be reported.
- (4) PER-ACRE forest soils (if eligible). Forest Soil carbon is assumed to not be effected by decreases in above ground live-biomass. Continue to report using the appropriate default table (Appendix B).

## **APPENDIX A**

# **Carbon Sequestration Registry Web Site**

## **User Guide**

**Prepared by the Georgia Superior Clerks Cooperative Authority**

## **Pages Available to the General Public**

### **Home Page**

The page named [www.gacarbon.org](http://www.gacarbon.org) is the Registry website home page. This page has links to the Login Page, Apply Online page, Search page, Contacts page and News page. The Home Page links to other pages depending on whether or not the user is logged-in and depending on the type of account the user has (Administrator, Forester, Participant and/or Landowner).

### **Login Page**

The Login Page, “login.aspx”, provides a place for users who have accounts on the website to log into the website. The user can simply enter a valid username and password and click the “Log In” button to log in. Optionally, the user can check the “Remember me next time” checkbox so that he can re-access the website from the same computer without re-entering his credentials.

If the user clicks the “Log In” button without entering his username and/or password, a red asterisk will appear next to the control that is missing the required information. If a user enters an invalid username and/or password, the page will display the message “Your login attempt was not successful. Please try again.”.

After 4 unsuccessful logins, the system will lock the user out (provided the username is valid and the password is invalid). This is meant to prevent an unauthorized user from attempting to guess the password of an authorized user. If an authorized user is locked-out, an Administrator can unlock the user’s account via the “Manage Users” link on the Administrator’s home page.

Following a successful login, the user is redirected to either the Home Page (if user is not a Participant) or the Participant Start Page (if the user is a Participant).

### **Search Page**

The “Search Projects” link on the Home Page redirects the user to the Project Search page. This page allows the user to search through all of the projects in the Registry via a variety of search criteria. The user can enter substrings to search for Projects which contain the substrings in their Project Name, Participant Name or Landowner Name. Dropdown lists provide choices for searching by Project Type, Restriction, Estimation Method, Market Availability and/or County. After specifying the search criteria, the user clicks the “Search” button and the page displays all projects which match the specified criteria.

Clicking the “Search” button without specifying any search criteria will display all of the projects in the Registry database.

A “Show Favorites” button on the page allows the user to display all of the projects which the user has added to his collection of favorite projects.

The search results show a block of information for each Project. The Project's name appears as a link which can be clicked to redirect the user to the Project Details page for the selected project. The Project's ID, Participant, Landowner, County(ies), Estimation Method, Restriction Status and Availability are displayed in the summary block in the search results listing. The summary block also contains a Compare checkbox allowing the user to select multiple (2 to 5) projects for a side-by-side comparison. There are links in the summary blocks which provide a means for the user to add the listed project to his Favorites collection or to remove the project from his favorites collection.

To perform a side-by-side comparison, the user checks the "Compare" checkbox in the summary block for each project to compare (between 2 and 5 projects) and then clicks the "Compare" button at the bottom of the list. The page will then display the summary information for the selected projects as a side-by-side comparison.

By default, the search results are displayed with only 5 projects per page. The user can navigate the pages of search results using the "First Page", "Previous Page", "Next Page" and "Last Page" links at the top and bottom of each page. One or more of these buttons will be disabled if the user is already on the page which the button links to (for example, if there is only one page of projects, then all buttons will be disabled because there is no Next or Previous page and the user is already viewing the First and Last page).

A "Results Per Page" selection allows the user to specify the number of projects to display on a single page. The user can select either 5, 10, 15, 20 or 25 projects per page.

### **Project Details Page**

Clicking the hyperlink on a search results block which displays a project's name redirects the user to the Project Details page for the selected project. This page displays detailed information about the project including acreage in each county, Deed Books and page numbers, etc.

The page has embedded controls that will render additional information if the logged-in user is an Administrator. Administrators will see all of the information that other users would see plus details about the Landowner and Participant including phone number, fax number and email.

The Project Detail page is also accessible to the administrator following the creation of a project. Upon creation of a new project, the Administrator is redirected to the Project Details page to view the details of the newly-created project.

### **Activity Report Pages**

The Activity Report Page for a project shows a year-by-year computation of the project's Total Carbon Stocks, Carbon Reductions, Carbon Emissions and Cumulative Activity. This report is produced by combining the same information for each of the project's parcels.

The project activity report will show a list of the projects parcels at the bottom of the page with a link for viewing the Activity Report Page for each individual parcel in the project.

The report is generated using “Actual” values for Stem, Soil and Forest Products carbon per acre stored in the database for each year. All years prior to the current year have the Stem, Soil and Forest Products values that were entered when each year was updated. The current and future years show “Actual” values which are set equal to estimated or projected values when the parcel is initially classified and when the project’s projected values are updated as the result of an annual update.

All values are reported in Metric Tons of Carbon Dioxide. These values are computed by multiplying the per-acre values stored in the database by the acreage values stored in the database

Since only the per-acre values for Stem, Soil and Forest Products are stored in the database, values such as the values in an activity report and values such as AGLB, BGLB, etc are all computed on an as-needed, on-demand basis.

### **News Page**

The News page is provided as a means for the Registry Administrators to display information regarding Registry news. The page contains a single XML control which renders formatted HTML (web page) content in the center of the page. Registry Administrators specify the content using a simple XML text file called “News.xml” which is stored in the “NewsAndContacts” folder on the web server. This simple file contains Headline, Dateline and BodyBlock tags which can be copied and pasted to create multiple news stories to display on the page. The Headline tag contains 2 attributes, “isLink” and “linkURL”, which can be used to make the Headline text a link to another web page on the same site or on another site. If these attributes are left out, the Headline text simply appears as bold text.

### **Contacts Page**

The Contacts page provides a display of contact information that Registry website visitors can use to contact Registry personnel. Like the News page, the Contacts page simply displays the HTML output of a single XML control. Registry Administrators can customize the web page by editing a simple XML text file called “Contacts.xml” which is located in the “NewsAndContacts” folder on the web server. For each Contact, the Contacts file contains HumanName, AddlInfo, Entity, Email, Phone and Hours tags. These tags can be used or left out in any combination to display as much or as little information as the Administrator desires.

### **Project Application Wizard**

The “Apply Online” link on the Home Page redirects the user to a page called “apply.aspx” which provides a means for the user to fill out an electronic version of a Registry Project Application. The application is presented in a wizard-style format. Separate panes of the wizard are used for the application’s Participant, Landowner, Project and Parcel information. The last page of the wizard displays all of the information entered by the user and allows the user to review the information before submitting it.

Once the user has reviewed the information on the “Review” pane of the wizard, the user can click a “Print for Mail-In” button to print a hardcopy of the application that the user can mail to the GFC or click the “Submit Electronically” button to send the application to the GFC via email.

If the application is submitted electronically, the email will contain all of the information entered by the user as an attachment to the email along with an identifying number for the application. A copy of the electronically-submitted application is stored in the Registry database as an XML file. The identifying number is used as a means to locate the stored copy of the application. The stored copy is provided as a convenience to Registry Administrators to prevent the need for re-keying the information entered by the user.

## **Administrator – Only Pages**

All of the pages discussed so far are accessible by any website visitor whether or not the visitor has an account on the website. The Home Page contains links which are rendered to the browser only if the user is logged-in and only if the account that the user is logged-in with is a member of a specific Role (e.g., Administrator, Forester, Participant, Landowner, etc). Administrators are the only users who will have the “Add User”, “Manage Users”, “Create Project” and “Manage Projects” links.

### **Create Projects**

Once an Administrator has received an application for a project, the Administrator reviews the information in the application to determine if a project should be created. If the Administrator decides to create the project, he uses the “Create Project” link to access the New Project page.

If the project application was submitted electronically, the Administrator simply copies the identifier from the application email and pastes it into the “Application GUID” box on the New Project page. The Administrator then selects the Participant, Landowner and Forester accounts to associate the project with from the provided dropdown lists and clicks the “Create” button to create the new project.

If the project application was not submitted electronically, the Administrator will have to enter all of the project information manually. The easiest way to do this is to go through the online application wizard and generate an Application GUID for the project and then create the project as if the application were submitted electronically.

After clicking the “Create” button, the project will be created based on the information in the application and the Administrator will be redirected to the Project Details page for the newly-created project.

The newly-created project will have a project status of “Pending” indicating that it has been created but has never been classified.

## **New User Page**

The New User page is accessed via the “Add user” link on the Administrator Home Page. This page provides a simple means for the Administrator to create accounts for the Registry Participants, Foresters, Landowners and other Administrators. This page is used by the Administrator prior to creating a new project in order to create any needed accounts for the project’s Participant, Landowner and Forester.

The Administrator provides a Username, Password and Email address for the new account and selects the Roles (Participant, Forester, etc) to make the new account a member of. Optionally, the Administrator enters personal information for the user such as the users name, address, phone, fax, etc. If desired, the Administrator can enter only a first and last name and then allow the user to enter his personal information at a later time.

After entering the required information and any optional information, the Administrator clicks the “Create User” button to create the account. The account is created and the Administrator is redirected to the Registry Home Page.

It is important for the Administrator to understand that accounts must be created for a project’s Participant, Landowner and Forester before these users will appear in the lists on the New Project page. Additionally, these user must be assigned to the appropriate Roles (i.e., the Participant must be assigned to the Participant Role, etc).

## **User Administration Page**

The “Manage Users” link on the Administrator’s Home Page links to a page provided for the Administrator to manage the website’s user accounts. The Administrator can use this page to delete user accounts from the website or to make changes to the accounts.

The page displays a list of the accounts in the accounts database. A “Delete” link allows the Administrator to delete an account. An “Edit” link opens a panel showing details about the selected account. Using the Edit Panel, the Administrator can change the Roles that the account is a member of, update the user’s email address, provide a description of the user and/or deactivate the user’s account. To deactivate the user’s account, the Administrator simply un-checks the “Approved” checkbox.

If the user’s account has been locked-out, the Edit Panel displays an “Unlock” button. Clicking the “Unlock” button removes the lock placed on the account by the web server’s operating system.

## **Project Administration Page**

The “Manage Projects” link on the Administrator’s Home page links to the Project Admin Page. This page is provided as a means for the Administrator to view a Project’s details and current status, change the status of a project (e.g., from Classified to Registered) or to flag a project as Out-of-Compliance (OOC).

A Project’s status is set to Pending when the project is first created. Once the Participant and Approved Forester have completed the process of classifying each of the Project’s Parcels, the project’s status is automatically set to Classified and the Administrator is notified via email regarding the status change. At this point, the Administrator reviews the classification information and other information and, if everything is in order (all fees received, all Parcel Maps received, etc). the Administrator uses the Project Admin page to set the project status to Registered. Only a Registered project may be updated.

## **Pages Available to Participants**

### **Participant Start Page**

When a user logs into the website, his account is checked to see if he is a member of the Participant Role. If the user is not a Participant (ie. If he is a Forester, Landowner and/or Administrator but not a Participant), the user is redirected from the Login page to the Registry Home Page. If the user is a Participant, the user is redirected from the Login Page to the Participant Start Page.

The Participant Start Page initially displays a list of the participant's projects along with the status of each project and links to Classify, Update or view an Activity report for the project. The links are enabled and disabled depending on the current status of the project.

A project with the status, Pending, will have its "Classify" link available. Clicking this link will redirect the participant to one of two pages depending on the projects current Estimation Method selection (Default Tables or Forest Inventory). These pages provide a means for the project's participant and approved forester to conduct the initial classification of the project. Classification is the process of specifying all of the technical information required to compute carbon estimates for each year of the life of the project.

Classification requires that a Forester be present in order to "sign-off" on the data entered during the classification process.

A project that has been classified and registered (such that its current status is "Registered" can be updated. Clicking the "Update" link on the Participant Start page initiates a process to check whether or not the project has already been updated for the current reporting year and whether or not the current date is within the update window of January 1 through July 1 of the year following the current reporting year. If so, the user is redirected to the update page.

Clicking the Activity link displays a report of Project Activity. The report shows a year-by-year summary of the project's Carbon Stocks, Carbon Emissions, Carbon Reductions and Cumulative Activity. The Project Activity Report page also shows links to individual report pages for each of the project's parcels.

The "My Projects" link on the Home Page is provided as a convenient link for a participant to easily return to the Participant Start Page.

### **Forest Inventory Classification Page**

Clicking the Classify link on the Participant Start Page for a project that uses the Forest Inventory Estimation Method redirects the user to the Forest Inventory Classification Page. This page initially displays a list of the parcels in the project and a Classify link for individually classifying each parcel. Clicking one of the Parcel Classify links displays a panel for entering

basic classification information including the inventory date, the age of the parcel on the inventory date and the starting year of the project.

Once the basic information has been entered, the user clicks the “Growth Projections” button to display a panel for entering estimates for Sawtimber, Pulpwood and Soil Carbon for each year of the project. In order to display the Growth Projections panel, the program need the information entered in the basic information panel in order to display the proper number of years in the Growth Projections panel.

The participant and forester fill out all of the information in the Growth Projections panel and, when finished, the Forester enters his username and password and clicks the “Save Parcel Classification” button. This saves the information to the Registry database and marks the parcel as Classified. If all of the projects are classified, then the project is marked as classified and the Administrator of the Registry is sent a notification email alerting him to the change in project status.

### **Default Tables Classification Page**

Clicking the Classify link on the Participant Start Page for a project that uses the Default Tables Estimation Method redirects the user to the Default Tables Classification Page. This page initially displays a list of the parcels in the project and a Classify link for individually classifying each parcel. Clicking one of the Parcel Classify links displays a panel for entering basic classification information including the Starting Age and Starting Year of the parcel. Dropdown lists provide selections for specifying the required values for estimation of carbon stocks using the tabular estimation methods.

Once the classification values are entered, the user clicks a “Forester Signoff” button. Clicking this button displays a table of carbon estimates for each year. The user can continue to make changes to the classification values and the table of estimates will be recomputed and automatically refreshed. When the Forester is satisfied with the classification values, he enters his username and password and clicks the “Save Parcel Classification” button. Clicking this button launches a check of the Forester’s credentials and, if valid Forester credentials were entered, saves the information to the database and marks the parcel as classified.

If all of the parcels in the project have been classified at this point, the system sends an email to the Registry Administrator notifying him of the change in project status.

### **Parcel Map Upload Page**

When the forester signs-off on a parcel classification, the web site displays the Parcel Map Upload Page. This page is provided as a means for the participant to upload a digital copy of a parcel map and have it stored in the Registry database as part of the project. If the participant does not have a digital copy of the parcel map, he can simply click the “Continue” button to skip this step.

If a user has a digital copy of a Parcel Map for the parcel which was just classified, he can click the “Browse” button to select the location of the parcel map on the participant’s PC and then click the “Upload Map” button to upload the file to the web server. The file is stored on the hard drive of the web server in the configured location (default is the “Parcel Maps” subfolder of the website folder so you are encouraged to change this location). The map’s file location (path), the parcel ID of the parcel the map is associated with and the date and time of the upload are stored in the Registry database in the ParcelMaps table.

## **Update Page**

After a project has been classified, its status changes to “Classified”. At this point, no changes can be made to the project until the Registry Administrator has marked the project as “Registered”. Once the project is marked as “registered”, the Participant Start Page will enable the “Update” button for the project if the project is due for an update.

Clicking the “Update” button redirects the user to the Update Page. The Update Page initially shows a table listing the parcels in the project. Each parcel will also have an update button which will be enabled if the parcel has not already been updated for the current reporting period. Clicking this “Update” button will display the current information found in the ParcelYears table of the database for each of the years of the project. The current reporting year (the current year minus one year) will be highlighted with bold text.

The participant will first decide whether he wishes to perform a “Standard Update” or an “Update with Changes”. A Standard Update does not permit the participant to change any information in the database and does not require a Forester to sign-off on the update. Clicking the “Standard Update” button simply sets the HasBeenUpdated flag for the ParcelYear to true and saves this information to the database.

If significant changes have taken place for the parcel, the participant must do a non-standard update. Before doing a non-standard update, the user may wish to change the Estimation Method. This option is only available if the current estimation method for the parcel is the Default Tables method. If this is the case, the participant will see a “Switch to Forest Inventory Method” button which he can click to change from the Default Tables method to the Forest Inventory method. Clicking this button displays a panel for the Forester to enter his credentials indicating that he has “signed-off” on the Estimation method change.

When the participant clicks the “Update With Changes” button, the page display will show controls for updating that depend on the current estimation method.

## **Default Tables Update Page**

If the current estimation method is the Default Tables method, the participant will see 5 buttons: “Report Year Thin”, “Change In Ownership”, “Report Disturbance”, “Change Restriction Status” “change market availability status” and “Finalize Update”.

Clicking “Change Restriction Status” displays a panel showing the current restriction status and providing a place for the Forester to sign-off on the status change. The Forester can either enter his credentials (username and password) and click the “Save” button or he can click the “Cancel” button to cancel the Restriction Status Change.

All 5 of the buttons work in the same manner. Clicking the button brings up a panel which displays and requests any necessary information and allows the Forester to either Cancel or Save the new information. All 4 report types and the Finalize Update button require Forester sign-off before any information is changed in the database. The ParcelYear will not be marked as “Updated” until the Finalize Update process has been completed.

The “Report Year Thin” button recalculates the Stem, Soil and Forest Products carbon estimates for the current reporting year and all subsequent years. The ParcelYears table displayed on the web page is updated to show the newly-computed information so that the Forester can review it prior to signing off on the Thin.

The “Change In Ownership” button displays a panel showing the current record of acres in each county that the parcel spans. The participant enters the number of acres removed from each county due to the change in ownership. Once the participant has entered the data, the Forester enters his credentials and clicks the “Save Ownership Update” button to save the information to the database.

The “Report Disturbance” button displays a panel in which the participant enters information about the disturbance. The Type of disturbance (Fire, Weather, Pests, etc) is selected from a dropdown list, details about the disturbance can be entered. The Participant enters the estimate of tons of carbon estimated to have gone into Forest Products as a result of the disturbance and the acres removed from each county that the parcel spans as a result of the disturbance. When all of the data has been entered, the forester enters his credentials and clicks the “Save Disturbance Update” button to save the information to the Registry database.

After all of the Thin, Disturbance, Change in Ownership and Change in Restriction Status information has been entered, the “Finalize Update” button is clicked and the Forester enters his credentials to indicate that all of the necessary information has been entered and the parcel should be marked as “Updated” for the current parcel reporting year. Once the parcel is marked as “Updated”, no further update reports can be entered.

## **Forest Inventory Update Page**

When the participant selects “Non-Standard Update” and the current estimation method for the parcel is “Forest Inventory”, the participant will see a panel with a table of parcel year information for the parcel. The table contains boxes in which the participant can input the Stem, Soil and Forest Products estimates for the current reporting year and for future years (revised estimates). Information for years prior to the current reporting year will be displayed but not editable. After the participant has entered all of the required information, the forester enters his credentials and clicks the “Save FI Update” button to save the information to the database. Once the information has been saved to the database, the parcel is marked as “Updated” for the current reporting year and further updates will not be allowed.

## **Pages Available to All Logged-In Users**

### **Update Personal Info Page**

Any user with an account for the Registry website will have access to a link which displays the Personal Information Update Page. This page initially displays the logged-in user’s Name, Address, Phone, etc information. The user can change this information at any time. Clicking the “Update” button saves all of the required information to the database.

### **Change Password Page**

All logged-in users have the ability to change their passwords using the “Change Password” link on the Home Page. The user is required to enter his current password and then enter and confirm the desired new password. Currently, passwords must be 7 characters long. Password requirements can be changed via the website’s configuration file.

# Appendix B

## Forest Carbon Estimation Tables: Forest Soils and Forest Products

**Table 1.** Factors to convert primary wood products to carbon mass from the units characteristic of each product.

**Table 2.** Fraction of carbon in primary wood products remaining in end uses up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

**Table 3.** Fraction of carbon in primary wood products remaining in landfills up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

**Table 4.** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

**Table 5.** Forest soil carbon accumulation tables for loblolly and/or shortleaf pine plantations established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of CO<sub>2</sub>e and short tons of Carbon. Soils data should be reported in short tons of carbon.

**Table 6.** Forest soil carbon accumulation tables for longleaf and/or slash pine plantations established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of CO<sub>2</sub>e and short tons of Carbon. Soils data should be reported in short tons of carbon.

**Table 7.** Forest soil carbon accumulation tables for oak-gum-cypress forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of CO<sub>2</sub>e and short tons of Carbon. Soils data should be reported in short tons of carbon.

**Table 8.** Forest soil carbon accumulation table for oak-pine forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of CO<sub>2</sub>e and short tons of Carbon. Soils data should be reported in short tons of carbon.

**Table 9.** Forest soil carbon accumulation table for oak-hickory forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of CO<sub>2</sub>e and short tons of Carbon. Soils data should be reported in short tons of carbon.

**Appendix B Table 1.** Factors to convert primary wood products to carbon mass from the units characteristic of each product

<b>Solidwood Product or Paper</b>	<b>Unit</b>	<b>Factor: convert to tons (2000 lbs) carbon</b>	<b>Factor: convert to tonnes carbon</b>
Softwood lumber/laminated veneer lumber/glulam lumber/l-joists	thousand board feet	0.488	0.443
Hardwood lumber	thousand board feet	0.844	0.765
Softwood plywood	thousand square feet: 3/8-inch basis	0.260	0.236
Oriented strandboard	thousand square feet: 3/8-inch basis	0.303	0.275
Non structural panels (average)	thousand square feet: 3/8-inch basis	0.319	0.289
Hardwood veneer/plywood	thousand square feet: 3/8-inch basis	0.315	0.286
Particleboard/medium density fiberboard	thousand square feet: 3/4-inch basis	0.647	0.587
Hardboard	thousand square feet: 1/8-inch basis	0.152	0.138
Insulation board	thousand square feet: 1/2-inch basis	0.242	0.220
Other industrial products	thousand cubic feet	8.250	7.484
Paper	air dry tons (2000 lbs)	0.450	0.496

**Appendix B Table 2.** Fraction of carbon in primary wood products remaining in end uses up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

Year after production	Softwood lumber	Hardwood lumber	Softwood plywood	Oriented strandboard	Non-structural panels	Miscellaneous products	Paper
0	1	1	1	1	1	1	1
1	0.973	0.938	0.976	0.983	0.969	0.944	0.845
2	0.947	0.882	0.952	0.967	0.939	0.891	0.713
3	0.922	0.831	0.930	0.952	0.911	0.841	0.603
4	0.898	0.784	0.909	0.937	0.883	0.794	0.509
5	0.875	0.741	0.888	0.922	0.857	0.749	0.430
6	0.854	0.701	0.869	0.908	0.832	0.707	0.360
7	0.833	0.665	0.850	0.895	0.808	0.667	0.299
8	0.813	0.631	0.832	0.881	0.785	0.630	0.243
9	0.795	0.600	0.815	0.869	0.763	0.595	0.192
10	0.777	0.571	0.798	0.856	0.741	0.561	0.149
11	0.760	0.545	0.782	0.844	0.721	0.530	0.115
12	0.743	0.520	0.767	0.832	0.701	0.500	0.088
13	0.728	0.497	0.752	0.821	0.683	0.472	0.068
14	0.712	0.476	0.738	0.810	0.665	0.445	0.052
15	0.698	0.456	0.724	0.799	0.647	0.420	0.040
16	0.684	0.438	0.711	0.789	0.630	0.397	0.030
17	0.671	0.421	0.698	0.778	0.614	0.375	0.023
18	0.658	0.405	0.685	0.768	0.599	0.354	0.018
19	0.645	0.389	0.673	0.759	0.584	0.334	0.013
20	0.633	0.375	0.662	0.749	0.569	0.315	0.009
21	0.622	0.362	0.650	0.740	0.555	0.297	0.006
22	0.611	0.349	0.639	0.731	0.542	0.281	0.005
23	0.600	0.337	0.629	0.722	0.529	0.265	0.004
24	0.589	0.326	0.619	0.713	0.517	0.250	0.003
25	0.579	0.316	0.609	0.705	0.505	0.236	0.002
26	0.569	0.306	0.599	0.697	0.493	0.223	0.002
27	0.560	0.296	0.589	0.689	0.482	0.210	0.001
28	0.551	0.287	0.580	0.681	0.471	0.198	0.001
29	0.542	0.278	0.571	0.673	0.460	0.187	0.001
30	0.533	0.270	0.563	0.666	0.450	0.177	0.001
31	0.525	0.263	0.554	0.658	0.440	0.167	0
32	0.517	0.255	0.546	0.651	0.431	0.157	0
33	0.509	0.248	0.538	0.644	0.421	0.149	0
34	0.501	0.241	0.530	0.637	0.412	0.140	0
35	0.494	0.235	0.522	0.630	0.404	0.132	0
36	0.487	0.229	0.515	0.623	0.395	0.125	0
37	0.480	0.223	0.508	0.617	0.387	0.118	0
38	0.473	0.217	0.500	0.610	0.379	0.111	0
39	0.466	0.211	0.493	0.604	0.372	0.105	0
40	0.459	0.206	0.487	0.598	0.364	0.099	0
41	0.453	0.201	0.480	0.592	0.357	0.094	0
42	0.447	0.196	0.474	0.586	0.350	0.088	0
43	0.441	0.191	0.467	0.580	0.343	0.083	0
44	0.435	0.187	0.461	0.574	0.337	0.079	0
45	0.429	0.183	0.455	0.568	0.330	0.074	0
46	0.423	0.178	0.449	0.563	0.324	0.070	0
47	0.418	0.174	0.443	0.557	0.318	0.066	0
48	0.413	0.170	0.437	0.552	0.312	0.063	0
49	0.407	0.166	0.432	0.546	0.306	0.059	0
50	0.402	0.163	0.426	0.541	0.301	0.056	0

(Continued on next page)

**Appendix B Table 2 (con't).** Fraction of carbon in primary wood products remaining in end uses up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

<b>Year after production</b>	<b>Softwood lumber</b>	<b>Hardwood lumber</b>	<b>Softwood plywood</b>	<b>Oriented strandboard</b>	<b>Non-structural panels</b>	<b>Miscellaneous products</b>	<b>Paper</b>
51	0.397	0.159	0.421	0.536	0.295	0.053	0
52	0.392	0.156	0.416	0.531	0.290	0.050	0
53	0.387	0.152	0.411	0.526	0.285	0.047	0
54	0.383	0.149	0.405	0.521	0.280	0.044	0
55	0.378	0.146	0.401	0.516	0.275	0.042	0
56	0.373	0.143	0.396	0.511	0.270	0.039	0
57	0.369	0.140	0.391	0.506	0.265	0.037	0
58	0.364	0.137	0.386	0.502	0.261	0.035	0
59	0.360	0.134	0.382	0.497	0.256	0.033	0
60	0.356	0.131	0.377	0.493	0.252	0.031	0
61	0.352	0.129	0.373	0.488	0.248	0.029	0
62	0.348	0.126	0.368	0.484	0.244	0.028	0
63	0.344	0.124	0.364	0.479	0.239	0.026	0
64	0.340	0.121	0.360	0.475	0.236	0.025	0
65	0.336	0.119	0.356	0.471	0.232	0.023	0
66	0.332	0.117	0.352	0.466	0.228	0.022	0
67	0.329	0.114	0.348	0.462	0.224	0.021	0
68	0.325	0.112	0.344	0.458	0.221	0.020	0
69	0.321	0.110	0.340	0.454	0.217	0.019	0
70	0.318	0.108	0.336	0.450	0.214	0.018	0
71	0.314	0.106	0.332	0.446	0.210	0.017	0
72	0.311	0.104	0.329	0.442	0.207	0.016	0
73	0.308	0.102	0.325	0.438	0.204	0.015	0
74	0.304	0.100	0.321	0.435	0.201	0.014	0
75	0.301	0.098	0.318	0.431	0.198	0.013	0
76	0.298	0.096	0.314	0.427	0.195	0.012	0
77	0.295	0.095	0.311	0.423	0.192	0.012	0
78	0.292	0.093	0.308	0.420	0.189	0.011	0
79	0.289	0.091	0.304	0.416	0.186	0.010	0
80	0.286	0.090	0.301	0.413	0.183	0.010	0
81	0.283	0.088	0.298	0.409	0.181	0.009	0
82	0.280	0.086	0.295	0.406	0.178	0.009	0
83	0.277	0.085	0.292	0.402	0.175	0.008	0
84	0.274	0.083	0.289	0.399	0.173	0.008	0
85	0.271	0.082	0.286	0.395	0.170	0.007	0
86	0.269	0.081	0.283	0.392	0.168	0.007	0
87	0.266	0.079	0.280	0.389	0.166	0.007	0
88	0.263	0.078	0.277	0.386	0.163	0.006	0
89	0.261	0.076	0.274	0.382	0.161	0.006	0
90	0.258	0.075	0.271	0.379	0.159	0.006	0
91	0.256	0.074	0.269	0.376	0.156	0.005	0
92	0.253	0.073	0.266	0.373	0.154	0.005	0
93	0.251	0.071	0.263	0.370	0.152	0.005	0
94	0.248	0.070	0.261	0.367	0.150	0.004	0
95	0.246	0.069	0.258	0.364	0.148	0.004	0
96	0.243	0.068	0.255	0.361	0.146	0.004	0
97	0.241	0.067	0.253	0.358	0.144	0.004	0
98	0.239	0.066	0.250	0.355	0.142	0.003	0
99	0.236	0.065	0.248	0.352	0.140	0.003	0
100	0.234	0.064	0.245	0.349	0.138	0.003	0

(End of Table 2)

**Appendix B Table 3.** Fraction of carbon in primary wood products remaining in landfills up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

Year after production	Softwood lumber	Hardwood lumber	Softwood plywood	Oriented strandboard	Non-structural panels	Miscellaneous products	Paper
0	0	0	0	0	0	0	0
1	0.018	0.041	0.016	0.011	0.021	0.037	0.051
2	0.035	0.078	0.032	0.021	0.040	0.072	0.093
3	0.051	0.111	0.046	0.032	0.059	0.104	0.128
4	0.067	0.141	0.060	0.041	0.076	0.134	0.155
5	0.081	0.168	0.073	0.050	0.093	0.163	0.178
6	0.094	0.193	0.085	0.059	0.108	0.189	0.196
7	0.107	0.215	0.096	0.068	0.123	0.213	0.211
8	0.119	0.235	0.107	0.076	0.137	0.236	0.225
9	0.130	0.254	0.118	0.084	0.151	0.257	0.236
10	0.141	0.270	0.128	0.091	0.163	0.277	0.245
11	0.151	0.285	0.137	0.098	0.176	0.296	0.251
12	0.161	0.299	0.146	0.105	0.187	0.313	0.254
13	0.170	0.312	0.155	0.112	0.198	0.329	0.255
14	0.178	0.323	0.163	0.118	0.208	0.344	0.255
15	0.187	0.334	0.171	0.124	0.218	0.357	0.253
16	0.194	0.344	0.178	0.130	0.227	0.370	0.251
17	0.202	0.352	0.185	0.136	0.236	0.382	0.248
18	0.209	0.361	0.192	0.142	0.245	0.393	0.245
19	0.215	0.368	0.199	0.147	0.253	0.403	0.242
20	0.222	0.375	0.205	0.152	0.261	0.413	0.239
21	0.228	0.381	0.211	0.157	0.268	0.422	0.235
22	0.234	0.387	0.217	0.162	0.275	0.430	0.232
23	0.239	0.392	0.222	0.167	0.282	0.438	0.228
24	0.245	0.397	0.227	0.171	0.288	0.445	0.224
25	0.250	0.402	0.233	0.176	0.294	0.451	0.221
26	0.255	0.406	0.238	0.180	0.300	0.457	0.218
27	0.259	0.410	0.242	0.184	0.306	0.463	0.214
28	0.264	0.414	0.247	0.188	0.311	0.468	0.211
29	0.268	0.417	0.251	0.192	0.316	0.473	0.209
30	0.272	0.421	0.256	0.196	0.321	0.477	0.206
31	0.276	0.424	0.260	0.200	0.326	0.481	0.203
32	0.280	0.426	0.264	0.204	0.330	0.485	0.200
33	0.284	0.429	0.268	0.207	0.335	0.488	0.198
34	0.287	0.432	0.272	0.211	0.339	0.491	0.196
35	0.291	0.434	0.275	0.214	0.343	0.494	0.194
36	0.294	0.436	0.279	0.217	0.347	0.497	0.191
37	0.298	0.438	0.282	0.221	0.350	0.499	0.189
38	0.301	0.440	0.286	0.224	0.354	0.502	0.187
39	0.304	0.442	0.289	0.227	0.357	0.504	0.186
40	0.307	0.444	0.292	0.230	0.361	0.506	0.184
41	0.310	0.446	0.295	0.233	0.364	0.507	0.182
42	0.312	0.447	0.298	0.236	0.367	0.509	0.181
43	0.315	0.449	0.301	0.239	0.370	0.510	0.179
44	0.318	0.450	0.304	0.241	0.373	0.512	0.178
45	0.320	0.452	0.307	0.244	0.376	0.513	0.176
46	0.323	0.453	0.309	0.247	0.378	0.514	0.175
47	0.325	0.454	0.312	0.249	0.381	0.515	0.174
48	0.328	0.456	0.315	0.252	0.384	0.516	0.173
49	0.330	0.457	0.317	0.255	0.386	0.516	0.172
50	0.332	0.458	0.320	0.257	0.388	0.517	0.171

(Continued on next page)

**Appendix B Table 3 (con't).** Fraction of carbon in primary wood products remaining in landfills up to 100 years after production (year 0 indicates fraction at time of production, with fraction for year 1 the allocation after 1 year)

Year after production	Softwood lumber	Hardwood lumber	Softwood plywood	Oriented strandboard	Non-structural panels	Miscellaneous products	Paper
51	0.334	0.459	0.322	0.260	0.391	0.518	0.170
52	0.337	0.460	0.324	0.262	0.393	0.518	0.169
53	0.339	0.461	0.327	0.264	0.395	0.519	0.168
54	0.341	0.462	0.329	0.267	0.397	0.519	0.167
55	0.343	0.463	0.331	0.269	0.399	0.520	0.166
56	0.345	0.464	0.333	0.271	0.401	0.520	0.165
57	0.347	0.465	0.335	0.273	0.403	0.520	0.164
58	0.348	0.466	0.338	0.276	0.405	0.520	0.164
59	0.350	0.467	0.340	0.278	0.407	0.521	0.163
60	0.352	0.468	0.342	0.280	0.408	0.521	0.162
61	0.354	0.468	0.344	0.282	0.410	0.521	0.162
62	0.356	0.469	0.345	0.284	0.412	0.521	0.161
63	0.357	0.470	0.347	0.286	0.413	0.521	0.161
64	0.359	0.471	0.349	0.288	0.415	0.521	0.160
65	0.361	0.472	0.351	0.290	0.417	0.521	0.160
66	0.362	0.472	0.353	0.292	0.418	0.521	0.159
67	0.364	0.473	0.355	0.294	0.420	0.521	0.159
68	0.365	0.474	0.356	0.296	0.421	0.521	0.158
69	0.367	0.474	0.358	0.298	0.422	0.521	0.158
70	0.369	0.475	0.360	0.300	0.424	0.521	0.157
71	0.370	0.476	0.361	0.302	0.425	0.521	0.157
72	0.371	0.476	0.363	0.303	0.426	0.521	0.157
73	0.373	0.477	0.365	0.305	0.428	0.521	0.156
74	0.374	0.477	0.366	0.307	0.429	0.521	0.156
75	0.376	0.478	0.368	0.309	0.430	0.521	0.156
76	0.377	0.479	0.369	0.310	0.431	0.521	0.155
77	0.378	0.479	0.371	0.312	0.433	0.521	0.155
78	0.380	0.480	0.372	0.314	0.434	0.521	0.155
79	0.381	0.480	0.374	0.316	0.435	0.521	0.155
80	0.382	0.481	0.375	0.317	0.436	0.521	0.154
81	0.384	0.481	0.376	0.319	0.437	0.520	0.154
82	0.385	0.482	0.378	0.320	0.438	0.520	0.154
83	0.386	0.482	0.379	0.322	0.439	0.520	0.154
84	0.387	0.483	0.381	0.324	0.440	0.520	0.153
85	0.389	0.483	0.382	0.325	0.441	0.520	0.153
86	0.390	0.484	0.383	0.327	0.442	0.520	0.153
87	0.391	0.484	0.385	0.328	0.443	0.520	0.153
88	0.392	0.485	0.386	0.330	0.444	0.520	0.153
89	0.393	0.485	0.387	0.331	0.445	0.520	0.153
90	0.395	0.486	0.388	0.333	0.446	0.519	0.152
91	0.396	0.486	0.390	0.334	0.447	0.519	0.152
92	0.397	0.486	0.391	0.336	0.448	0.519	0.152
93	0.398	0.487	0.392	0.337	0.449	0.519	0.152
94	0.399	0.487	0.393	0.339	0.449	0.519	0.152
95	0.400	0.488	0.394	0.340	0.450	0.519	0.152
96	0.401	0.488	0.395	0.342	0.451	0.519	0.152
97	0.402	0.488	0.397	0.343	0.452	0.519	0.152
98	0.403	0.489	0.398	0.344	0.453	0.519	0.152
99	0.404	0.489	0.399	0.346	0.453	0.519	0.151
100	0.405	0.490	0.400	0.347	0.454	0.518	0.151

(End of Table 3)

**Appendix B Table 4.** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

Softwood/ Hardwood	Saw log/ Pulpwood/ All	Year after production	Fraction: in use	Fraction: landfills	Fraction: energy	Fraction: emitted
Softwood	Saw log	0	0.636	0.000	0.260	0.104
Softwood	Saw log	1	0.601	0.017	0.270	0.112
Softwood	Saw log	2	0.570	0.032	0.279	0.119
Softwood	Saw log	3	0.541	0.045	0.288	0.125
Softwood	Saw log	4	0.516	0.057	0.296	0.131
Softwood	Saw log	5	0.493	0.068	0.303	0.136
Softwood	Saw log	6	0.472	0.078	0.310	0.140
Softwood	Saw log	7	0.453	0.087	0.315	0.145
Softwood	Saw log	8	0.435	0.095	0.321	0.149
Softwood	Saw log	9	0.418	0.103	0.326	0.153
Softwood	Saw log	10	0.402	0.110	0.331	0.157
Softwood	Saw log	11	0.388	0.117	0.335	0.160
Softwood	Saw log	12	0.376	0.122	0.339	0.163
Softwood	Saw log	13	0.365	0.127	0.342	0.166
Softwood	Saw log	14	0.354	0.132	0.345	0.169
Softwood	Saw log	15	0.345	0.136	0.347	0.172
Softwood	Saw log	16	0.336	0.140	0.349	0.174
Softwood	Saw log	17	0.328	0.144	0.352	0.177
Softwood	Saw log	18	0.320	0.147	0.354	0.179
Softwood	Saw log	19	0.312	0.150	0.355	0.182
Softwood	Saw log	20	0.306	0.153	0.357	0.184
Softwood	Saw log	21	0.299	0.156	0.359	0.186
Softwood	Saw log	22	0.293	0.159	0.360	0.188
Softwood	Saw log	23	0.287	0.161	0.362	0.190
Softwood	Saw log	24	0.281	0.164	0.363	0.192
Softwood	Saw log	25	0.276	0.166	0.364	0.194
Softwood	Saw log	26	0.270	0.168	0.366	0.196
Softwood	Saw log	27	0.265	0.170	0.367	0.198
Softwood	Saw log	28	0.260	0.172	0.368	0.199
Softwood	Saw log	29	0.256	0.174	0.369	0.201
Softwood	Saw log	30	0.251	0.176	0.370	0.203
Softwood	Saw log	31	0.247	0.178	0.371	0.205
Softwood	Saw log	32	0.243	0.179	0.372	0.206
Softwood	Saw log	33	0.238	0.181	0.373	0.208
Softwood	Saw log	34	0.235	0.182	0.374	0.210
Softwood	Saw log	35	0.231	0.184	0.374	0.211
Softwood	Saw log	36	0.227	0.185	0.375	0.213
Softwood	Saw log	37	0.223	0.187	0.376	0.214
Softwood	Saw log	38	0.220	0.188	0.377	0.216
Softwood	Saw log	39	0.216	0.189	0.377	0.217
Softwood	Saw log	40	0.213	0.190	0.378	0.219
Softwood	Saw log	41	0.210	0.192	0.378	0.220
Softwood	Saw log	42	0.207	0.193	0.379	0.221
Softwood	Saw log	43	0.204	0.194	0.380	0.223
Softwood	Saw log	44	0.201	0.195	0.380	0.224
Softwood	Saw log	45	0.198	0.196	0.381	0.226
Softwood	Saw log	46	0.195	0.197	0.381	0.227
Softwood	Saw log	47	0.192	0.198	0.381	0.228
Softwood	Saw log	48	0.189	0.199	0.382	0.229
Softwood	Saw log	49	0.187	0.200	0.382	0.231
Softwood	Saw log	50	0.184	0.201	0.383	0.232

(Continued on next page)

**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

<b>Softwood/ Hardwood</b>	<b>Saw log/ Pulpwood/ All</b>	<b>Year after production</b>	<b>Fraction: in use</b>	<b>Fraction: landfills</b>	<b>Fraction: energy</b>	<b>Fraction: emitted</b>
Softwood	Saw log	51	0.182	0.202	0.383	0.233
Softwood	Saw log	52	0.179	0.203	0.383	0.234
Softwood	Saw log	53	0.177	0.204	0.384	0.236
Softwood	Saw log	54	0.175	0.205	0.384	0.237
Softwood	Saw log	55	0.172	0.206	0.384	0.238
Softwood	Saw log	56	0.170	0.206	0.384	0.239
Softwood	Saw log	57	0.168	0.207	0.385	0.240
Softwood	Saw log	58	0.166	0.208	0.385	0.241
Softwood	Saw log	59	0.164	0.209	0.385	0.243
Softwood	Saw log	60	0.162	0.209	0.385	0.244
Softwood	Saw log	61	0.160	0.210	0.385	0.245
Softwood	Saw log	62	0.158	0.211	0.386	0.246
Softwood	Saw log	63	0.156	0.212	0.386	0.247
Softwood	Saw log	64	0.154	0.212	0.386	0.248
Softwood	Saw log	65	0.152	0.213	0.386	0.249
Softwood	Saw log	66	0.150	0.214	0.386	0.250
Softwood	Saw log	67	0.149	0.214	0.386	0.251
Softwood	Saw log	68	0.147	0.215	0.386	0.252
Softwood	Saw log	69	0.145	0.216	0.386	0.253
Softwood	Saw log	70	0.144	0.216	0.386	0.254
Softwood	Saw log	71	0.142	0.217	0.386	0.255
Softwood	Saw log	72	0.140	0.218	0.386	0.256
Softwood	Saw log	73	0.139	0.218	0.386	0.257
Softwood	Saw log	74	0.137	0.219	0.386	0.258
Softwood	Saw log	75	0.136	0.219	0.386	0.259
Softwood	Saw log	76	0.134	0.220	0.386	0.260
Softwood	Saw log	77	0.133	0.221	0.386	0.260
Softwood	Saw log	78	0.131	0.221	0.386	0.261
Softwood	Saw log	79	0.130	0.222	0.386	0.262
Softwood	Saw log	80	0.128	0.222	0.386	0.263
Softwood	Saw log	81	0.127	0.223	0.386	0.264
Softwood	Saw log	82	0.126	0.223	0.386	0.265
Softwood	Saw log	83	0.124	0.224	0.386	0.265
Softwood	Saw log	84	0.123	0.224	0.386	0.266
Softwood	Saw log	85	0.122	0.225	0.386	0.267
Softwood	Saw log	86	0.120	0.225	0.386	0.268
Softwood	Saw log	87	0.119	0.226	0.386	0.268
Softwood	Saw log	88	0.118	0.227	0.386	0.269
Softwood	Saw log	89	0.117	0.227	0.386	0.270
Softwood	Saw log	90	0.116	0.227	0.386	0.271
Softwood	Saw log	91	0.114	0.228	0.386	0.271
Softwood	Saw log	92	0.113	0.228	0.386	0.272
Softwood	Saw log	93	0.112	0.229	0.386	0.273
Softwood	Saw log	94	0.111	0.229	0.386	0.273
Softwood	Saw log	95	0.110	0.230	0.386	0.274
Softwood	Saw log	96	0.109	0.230	0.386	0.275
Softwood	Saw log	97	0.108	0.231	0.386	0.275
Softwood	Saw log	98	0.107	0.231	0.386	0.276
Softwood	Saw log	99	0.106	0.232	0.386	0.276
Softwood	Saw log	100	0.104	0.232	0.386	0.277

*(Continued on next page)*

**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

<b>Softwood/ Hardwood</b>	<b>Saw log/ Pulpwood/ All</b>	<b>Year After Production</b>	<b>Fraction: in use</b>	<b>Fraction: Landfills</b>	<b>Fraction: Energy</b>	<b>Fraction: Emitted</b>
Softwood	Pulpwood	0	0.553	0.000	0.276	0.171
Softwood	Pulpwood	1	0.482	0.024	0.300	0.193
Softwood	Pulpwood	2	0.422	0.044	0.323	0.211
Softwood	Pulpwood	3	0.370	0.061	0.342	0.227
Softwood	Pulpwood	4	0.327	0.074	0.359	0.241
Softwood	Pulpwood	5	0.290	0.085	0.373	0.252
Softwood	Pulpwood	6	0.257	0.094	0.385	0.263
Softwood	Pulpwood	7	0.229	0.102	0.396	0.273
Softwood	Pulpwood	8	0.202	0.109	0.407	0.282
Softwood	Pulpwood	9	0.178	0.115	0.416	0.291
Softwood	Pulpwood	10	0.158	0.119	0.425	0.298
Softwood	Pulpwood	11	0.141	0.123	0.431	0.305
Softwood	Pulpwood	12	0.128	0.125	0.437	0.311
Softwood	Pulpwood	13	0.117	0.126	0.441	0.316
Softwood	Pulpwood	14	0.109	0.127	0.445	0.320
Softwood	Pulpwood	15	0.102	0.127	0.448	0.323
Softwood	Pulpwood	16	0.097	0.126	0.450	0.327
Softwood	Pulpwood	17	0.093	0.126	0.452	0.330
Softwood	Pulpwood	18	0.089	0.125	0.453	0.332
Softwood	Pulpwood	19	0.086	0.124	0.455	0.335
Softwood	Pulpwood	20	0.083	0.123	0.456	0.337
Softwood	Pulpwood	21	0.081	0.122	0.457	0.340
Softwood	Pulpwood	22	0.079	0.121	0.458	0.342
Softwood	Pulpwood	23	0.078	0.120	0.459	0.343
Softwood	Pulpwood	24	0.076	0.119	0.459	0.345
Softwood	Pulpwood	25	0.075	0.118	0.460	0.347
Softwood	Pulpwood	26	0.074	0.117	0.460	0.349
Softwood	Pulpwood	27	0.073	0.116	0.461	0.350
Softwood	Pulpwood	28	0.072	0.115	0.461	0.352
Softwood	Pulpwood	29	0.071	0.114	0.461	0.353
Softwood	Pulpwood	30	0.070	0.113	0.462	0.355
Softwood	Pulpwood	31	0.069	0.113	0.462	0.356
Softwood	Pulpwood	32	0.069	0.112	0.462	0.357
Softwood	Pulpwood	33	0.068	0.111	0.462	0.359
Softwood	Pulpwood	34	0.067	0.110	0.462	0.360
Softwood	Pulpwood	35	0.066	0.110	0.463	0.361
Softwood	Pulpwood	36	0.066	0.109	0.463	0.363
Softwood	Pulpwood	37	0.065	0.109	0.463	0.364
Softwood	Pulpwood	38	0.064	0.108	0.463	0.365
Softwood	Pulpwood	39	0.063	0.108	0.463	0.366
Softwood	Pulpwood	40	0.063	0.107	0.463	0.367
Softwood	Pulpwood	41	0.062	0.107	0.463	0.368
Softwood	Pulpwood	42	0.061	0.106	0.463	0.369
Softwood	Pulpwood	43	0.061	0.106	0.463	0.370
Softwood	Pulpwood	44	0.060	0.106	0.463	0.371
Softwood	Pulpwood	45	0.060	0.105	0.463	0.372
Softwood	Pulpwood	46	0.059	0.105	0.463	0.373
Softwood	Pulpwood	47	0.058	0.105	0.463	0.374
Softwood	Pulpwood	48	0.058	0.105	0.463	0.375
Softwood	Pulpwood	49	0.057	0.104	0.463	0.375
Softwood	Pulpwood	50	0.057	0.104	0.463	0.376

**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

<b>Softwood/ Hardwood</b>	<b>Saw log/ Pulpwood/ All</b>	<b>Year after Production</b>	<b>Fraction: in Use</b>	<b>Fraction: Landfills</b>	<b>Fraction: energy</b>	<b>Fraction: emitted</b>
Softwood	Pulpwood	51	0.056	0.104	0.463	0.377
Softwood	Pulpwood	52	0.056	0.104	0.463	0.378
Softwood	Pulpwood	53	0.055	0.104	0.463	0.378
Softwood	Pulpwood	54	0.055	0.103	0.463	0.379
Softwood	Pulpwood	55	0.054	0.103	0.463	0.380
Softwood	Pulpwood	56	0.054	0.103	0.463	0.380
Softwood	Pulpwood	57	0.053	0.103	0.463	0.381
Softwood	Pulpwood	58	0.053	0.103	0.463	0.382
Softwood	Pulpwood	59	0.052	0.103	0.463	0.382
Softwood	Pulpwood	60	0.052	0.103	0.463	0.383
Softwood	Pulpwood	61	0.051	0.103	0.463	0.383
Softwood	Pulpwood	62	0.051	0.103	0.463	0.384
Softwood	Pulpwood	63	0.050	0.103	0.463	0.384
Softwood	Pulpwood	64	0.050	0.103	0.463	0.385
Softwood	Pulpwood	65	0.049	0.103	0.463	0.385
Softwood	Pulpwood	66	0.049	0.103	0.463	0.386
Softwood	Pulpwood	67	0.048	0.103	0.463	0.386
Softwood	Pulpwood	68	0.048	0.103	0.463	0.386
Softwood	Pulpwood	69	0.047	0.103	0.463	0.387
Softwood	Pulpwood	70	0.047	0.103	0.463	0.387
Softwood	Pulpwood	71	0.047	0.103	0.463	0.388
Softwood	Pulpwood	72	0.046	0.103	0.463	0.388
Softwood	Pulpwood	73	0.046	0.103	0.463	0.388
Softwood	Pulpwood	74	0.045	0.103	0.463	0.389
Softwood	Pulpwood	75	0.045	0.103	0.463	0.389
Softwood	Pulpwood	76	0.045	0.103	0.463	0.389
Softwood	Pulpwood	77	0.044	0.103	0.463	0.390
Softwood	Pulpwood	78	0.044	0.103	0.463	0.390
Softwood	Pulpwood	79	0.043	0.103	0.463	0.390
Softwood	Pulpwood	80	0.043	0.103	0.463	0.391
Softwood	Pulpwood	81	0.043	0.103	0.463	0.391
Softwood	Pulpwood	82	0.042	0.103	0.463	0.391
Softwood	Pulpwood	83	0.042	0.103	0.463	0.392
Softwood	Pulpwood	84	0.042	0.104	0.463	0.392
Softwood	Pulpwood	85	0.041	0.104	0.463	0.392
Softwood	Pulpwood	86	0.041	0.104	0.463	0.392
Softwood	Pulpwood	87	0.041	0.104	0.463	0.393
Softwood	Pulpwood	88	0.040	0.104	0.463	0.393
Softwood	Pulpwood	89	0.040	0.104	0.463	0.393
Softwood	Pulpwood	90	0.040	0.104	0.463	0.393
Softwood	Pulpwood	91	0.039	0.104	0.463	0.394
Softwood	Pulpwood	92	0.039	0.104	0.463	0.394
Softwood	Pulpwood	93	0.039	0.104	0.463	0.394
Softwood	Pulpwood	94	0.038	0.104	0.463	0.394
Softwood	Pulpwood	95	0.038	0.105	0.463	0.395
Softwood	Pulpwood	96	0.038	0.105	0.463	0.395
Softwood	Pulpwood	97	0.037	0.105	0.463	0.395
Softwood	Pulpwood	98	0.037	0.105	0.463	0.395
Softwood	Pulpwood	99	0.037	0.105	0.463	0.395
Softwood	Pulpwood	100	0.036	0.105	0.463	0.396

*(Continued on next page)*

**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

<b>Softwood/ Hardwood</b>	<b>Saw log/ Pulpwood/ All</b>	<b>Year After Production</b>	<b>Fraction: in Use</b>	<b>Fraction: Landfills</b>	<b>Fraction: Energy</b>	<b>Fraction: Emitted</b>
Hardwood	Saw log	0	0.609	0.000	0.225	0.166
Hardwood	Saw log	1	0.565	0.025	0.234	0.176
Hardwood	Saw log	2	0.526	0.047	0.243	0.184
Hardwood	Saw log	3	0.491	0.066	0.252	0.192
Hardwood	Saw log	4	0.459	0.083	0.259	0.198
Hardwood	Saw log	5	0.431	0.099	0.266	0.205
Hardwood	Saw log	6	0.405	0.113	0.272	0.210
Hardwood	Saw log	7	0.381	0.126	0.278	0.216
Hardwood	Saw log	8	0.359	0.137	0.283	0.221
Hardwood	Saw log	9	0.339	0.147	0.288	0.225
Hardwood	Saw log	10	0.321	0.157	0.293	0.230
Hardwood	Saw log	11	0.304	0.165	0.297	0.234
Hardwood	Saw log	12	0.289	0.172	0.301	0.238
Hardwood	Saw log	13	0.276	0.179	0.304	0.241
Hardwood	Saw log	14	0.263	0.185	0.307	0.244
Hardwood	Saw log	15	0.252	0.190	0.310	0.248
Hardwood	Saw log	16	0.242	0.195	0.313	0.250
Hardwood	Saw log	17	0.232	0.200	0.315	0.253
Hardwood	Saw log	18	0.223	0.204	0.318	0.256
Hardwood	Saw log	19	0.215	0.207	0.320	0.258
Hardwood	Saw log	20	0.207	0.211	0.322	0.261
Hardwood	Saw log	21	0.200	0.214	0.324	0.263
Hardwood	Saw log	22	0.193	0.217	0.326	0.265
Hardwood	Saw log	23	0.186	0.219	0.327	0.267
Hardwood	Saw log	24	0.180	0.222	0.329	0.269
Hardwood	Saw log	25	0.175	0.224	0.331	0.271
Hardwood	Saw log	26	0.169	0.226	0.332	0.273
Hardwood	Saw log	27	0.164	0.228	0.334	0.275
Hardwood	Saw log	28	0.159	0.230	0.335	0.276
Hardwood	Saw log	29	0.155	0.231	0.336	0.278
Hardwood	Saw log	30	0.150	0.233	0.337	0.280
Hardwood	Saw log	31	0.146	0.234	0.339	0.281
Hardwood	Saw log	32	0.142	0.236	0.340	0.283
Hardwood	Saw log	33	0.138	0.237	0.341	0.284
Hardwood	Saw log	34	0.134	0.238	0.342	0.286
Hardwood	Saw log	35	0.131	0.239	0.343	0.287
Hardwood	Saw log	36	0.127	0.240	0.344	0.289
Hardwood	Saw log	37	0.124	0.241	0.345	0.290
Hardwood	Saw log	38	0.121	0.242	0.346	0.291
Hardwood	Saw log	39	0.118	0.243	0.346	0.292
Hardwood	Saw log	40	0.115	0.244	0.347	0.294
Hardwood	Saw log	41	0.112	0.245	0.348	0.295
Hardwood	Saw log	42	0.110	0.246	0.349	0.296
Hardwood	Saw log	43	0.107	0.246	0.349	0.297
Hardwood	Saw log	44	0.105	0.247	0.350	0.298
Hardwood	Saw log	45	0.102	0.248	0.351	0.299
Hardwood	Saw log	46	0.100	0.249	0.351	0.300
Hardwood	Saw log	47	0.098	0.249	0.352	0.301
Hardwood	Saw log	48	0.095	0.250	0.352	0.302
Hardwood	Saw log	49	0.093	0.250	0.353	0.303
Hardwood	Saw log	50	0.091	0.251	0.353	0.304

(Continued on next page)

**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

<b>Softwood/ Hardwood</b>	<b>Saw log/ Pulpwood/ All</b>	<b>Year After Production</b>	<b>Fraction: in Use</b>	<b>Fraction: Landfills</b>	<b>Fraction: Energy</b>	<b>Fraction: Emitted</b>
Hardwood	Saw log	51	0.089	0.252	0.354	0.305
Hardwood	Saw log	52	0.087	0.252	0.354	0.306
Hardwood	Saw log	53	0.086	0.253	0.355	0.307
Hardwood	Saw log	54	0.084	0.253	0.355	0.308
Hardwood	Saw log	55	0.082	0.254	0.355	0.309
Hardwood	Saw log	56	0.080	0.254	0.356	0.310
Hardwood	Saw log	57	0.079	0.255	0.356	0.311
Hardwood	Saw log	58	0.077	0.255	0.357	0.311
Hardwood	Saw log	59	0.076	0.255	0.357	0.312
Hardwood	Saw log	60	0.074	0.256	0.357	0.313
Hardwood	Saw log	61	0.073	0.256	0.357	0.314
Hardwood	Saw log	62	0.071	0.257	0.358	0.314
Hardwood	Saw log	63	0.070	0.257	0.358	0.315
Hardwood	Saw log	64	0.068	0.257	0.358	0.316
Hardwood	Saw log	65	0.067	0.258	0.358	0.317
Hardwood	Saw log	66	0.066	0.258	0.359	0.317
Hardwood	Saw log	67	0.065	0.259	0.359	0.318
Hardwood	Saw log	68	0.063	0.259	0.359	0.319
Hardwood	Saw log	69	0.062	0.259	0.359	0.319
Hardwood	Saw log	70	0.061	0.260	0.359	0.320
Hardwood	Saw log	71	0.060	0.260	0.360	0.321
Hardwood	Saw log	72	0.059	0.260	0.360	0.321
Hardwood	Saw log	73	0.058	0.261	0.360	0.322
Hardwood	Saw log	74	0.057	0.261	0.360	0.322
Hardwood	Saw log	75	0.056	0.261	0.360	0.323
Hardwood	Saw log	76	0.055	0.261	0.360	0.323
Hardwood	Saw log	77	0.054	0.262	0.360	0.324
Hardwood	Saw log	78	0.053	0.262	0.361	0.325
Hardwood	Saw log	79	0.052	0.262	0.361	0.325
Hardwood	Saw log	80	0.051	0.263	0.361	0.326
Hardwood	Saw log	81	0.050	0.263	0.361	0.326
Hardwood	Saw log	82	0.049	0.263	0.361	0.327
Hardwood	Saw log	83	0.048	0.263	0.361	0.327
Hardwood	Saw log	84	0.048	0.264	0.361	0.328
Hardwood	Saw log	85	0.047	0.264	0.361	0.328
Hardwood	Saw log	86	0.046	0.264	0.361	0.329
Hardwood	Saw log	87	0.045	0.264	0.361	0.329
Hardwood	Saw log	88	0.045	0.265	0.361	0.330
Hardwood	Saw log	89	0.044	0.265	0.361	0.330
Hardwood	Saw log	90	0.043	0.265	0.361	0.331
Hardwood	Saw log	91	0.042	0.265	0.361	0.331
Hardwood	Saw log	92	0.042	0.266	0.361	0.332
Hardwood	Saw log	93	0.041	0.266	0.361	0.332
Hardwood	Saw log	94	0.040	0.266	0.361	0.332
Hardwood	Saw log	95	0.040	0.266	0.361	0.333
Hardwood	Saw log	96	0.039	0.267	0.361	0.333
Hardwood	Saw log	97	0.038	0.267	0.361	0.334
Hardwood	Saw log	98	0.038	0.267	0.361	0.334
Hardwood	Saw log	99	0.037	0.267	0.361	0.334
Hardwood	Saw log	100	0.037	0.267	0.361	0.335

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**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

Softwood/ Hardwood	Saw log/ Pulpwood/ All	Year After Production	Fraction: in Use	Fraction: Landfills	Fraction: Energy	Fraction: Emitted
Hardwood	Pulpwood	0	0.591	0.000	0.225	0.185
Hardwood	Pulpwood	1	0.524	0.023	0.245	0.208
Hardwood	Pulpwood	2	0.467	0.042	0.263	0.227
Hardwood	Pulpwood	3	0.419	0.058	0.279	0.244
Hardwood	Pulpwood	4	0.378	0.071	0.293	0.258
Hardwood	Pulpwood	5	0.343	0.082	0.305	0.271
Hardwood	Pulpwood	6	0.312	0.091	0.315	0.282
Hardwood	Pulpwood	7	0.285	0.099	0.324	0.292
Hardwood	Pulpwood	8	0.259	0.106	0.333	0.302
Hardwood	Pulpwood	9	0.236	0.112	0.341	0.311
Hardwood	Pulpwood	10	0.216	0.117	0.348	0.319
Hardwood	Pulpwood	11	0.200	0.121	0.354	0.326
Hardwood	Pulpwood	12	0.187	0.123	0.358	0.332
Hardwood	Pulpwood	13	0.176	0.125	0.362	0.337
Hardwood	Pulpwood	14	0.168	0.126	0.365	0.341
Hardwood	Pulpwood	15	0.161	0.126	0.368	0.345
Hardwood	Pulpwood	16	0.155	0.126	0.370	0.349
Hardwood	Pulpwood	17	0.150	0.126	0.371	0.352
Hardwood	Pulpwood	18	0.146	0.126	0.373	0.355
Hardwood	Pulpwood	19	0.142	0.126	0.374	0.357
Hardwood	Pulpwood	20	0.139	0.125	0.376	0.360
Hardwood	Pulpwood	21	0.136	0.125	0.377	0.362
Hardwood	Pulpwood	22	0.134	0.124	0.377	0.364
Hardwood	Pulpwood	23	0.132	0.124	0.378	0.366
Hardwood	Pulpwood	24	0.130	0.123	0.379	0.368
Hardwood	Pulpwood	25	0.128	0.123	0.379	0.370
Hardwood	Pulpwood	26	0.127	0.122	0.380	0.372
Hardwood	Pulpwood	27	0.125	0.121	0.380	0.373
Hardwood	Pulpwood	28	0.123	0.121	0.381	0.375
Hardwood	Pulpwood	29	0.122	0.120	0.381	0.376
Hardwood	Pulpwood	30	0.121	0.120	0.382	0.378
Hardwood	Pulpwood	31	0.119	0.120	0.382	0.379
Hardwood	Pulpwood	32	0.118	0.119	0.382	0.381
Hardwood	Pulpwood	33	0.116	0.119	0.383	0.382
Hardwood	Pulpwood	34	0.115	0.119	0.383	0.383
Hardwood	Pulpwood	35	0.114	0.118	0.383	0.385
Hardwood	Pulpwood	36	0.113	0.118	0.383	0.386
Hardwood	Pulpwood	37	0.112	0.118	0.383	0.387
Hardwood	Pulpwood	38	0.110	0.118	0.384	0.388
Hardwood	Pulpwood	39	0.109	0.117	0.384	0.390
Hardwood	Pulpwood	40	0.108	0.117	0.384	0.391
Hardwood	Pulpwood	41	0.107	0.117	0.384	0.392
Hardwood	Pulpwood	42	0.106	0.117	0.384	0.393
Hardwood	Pulpwood	43	0.105	0.117	0.384	0.394
Hardwood	Pulpwood	44	0.104	0.117	0.384	0.395
Hardwood	Pulpwood	45	0.103	0.117	0.384	0.396
Hardwood	Pulpwood	46	0.102	0.117	0.385	0.397
Hardwood	Pulpwood	47	0.101	0.117	0.385	0.398
Hardwood	Pulpwood	48	0.100	0.117	0.385	0.399
Hardwood	Pulpwood	49	0.099	0.117	0.385	0.400
Hardwood	Pulpwood	50	0.098	0.117	0.385	0.401

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**Appendix B Table 4 (con't).** Average disposition patterns of carbon as fractions in industrial roundwood by roundwood category; factors assume no bark on industrial roundwood, which also excludes fuelwood

Softwood/ Hardwood	Saw log/ Pulpwood/ All	Year After Production	Fraction: in Use	Fraction: Landfills	Fraction: Energy	Fraction: Emitted
Hardwood	Pulpwood	51	0.097	0.117	0.385	0.402
Hardwood	Pulpwood	52	0.096	0.117	0.385	0.403
Hardwood	Pulpwood	53	0.095	0.117	0.385	0.404
Hardwood	Pulpwood	54	0.094	0.117	0.385	0.404
Hardwood	Pulpwood	55	0.093	0.117	0.385	0.405
Hardwood	Pulpwood	56	0.092	0.117	0.385	0.406
Hardwood	Pulpwood	57	0.091	0.117	0.385	0.407
Hardwood	Pulpwood	58	0.091	0.117	0.385	0.408
Hardwood	Pulpwood	59	0.090	0.117	0.385	0.408
Hardwood	Pulpwood	60	0.089	0.117	0.385	0.409
Hardwood	Pulpwood	61	0.088	0.118	0.385	0.410
Hardwood	Pulpwood	62	0.087	0.118	0.385	0.410
Hardwood	Pulpwood	63	0.086	0.118	0.385	0.411
Hardwood	Pulpwood	64	0.086	0.118	0.385	0.412
Hardwood	Pulpwood	65	0.085	0.118	0.385	0.412
Hardwood	Pulpwood	66	0.084	0.118	0.385	0.413
Hardwood	Pulpwood	67	0.083	0.118	0.385	0.413
Hardwood	Pulpwood	68	0.083	0.119	0.385	0.414
Hardwood	Pulpwood	69	0.082	0.119	0.385	0.415
Hardwood	Pulpwood	70	0.081	0.119	0.385	0.415
Hardwood	Pulpwood	71	0.081	0.119	0.385	0.416
Hardwood	Pulpwood	72	0.080	0.119	0.385	0.416
Hardwood	Pulpwood	73	0.079	0.120	0.385	0.417
Hardwood	Pulpwood	74	0.078	0.120	0.385	0.417
Hardwood	Pulpwood	75	0.078	0.120	0.385	0.418
Hardwood	Pulpwood	76	0.077	0.120	0.385	0.418
Hardwood	Pulpwood	77	0.076	0.120	0.385	0.419
Hardwood	Pulpwood	78	0.076	0.120	0.385	0.419
Hardwood	Pulpwood	79	0.075	0.121	0.385	0.420
Hardwood	Pulpwood	80	0.074	0.121	0.385	0.420
Hardwood	Pulpwood	81	0.074	0.121	0.385	0.420
Hardwood	Pulpwood	82	0.073	0.121	0.385	0.421
Hardwood	Pulpwood	83	0.073	0.122	0.385	0.421
Hardwood	Pulpwood	84	0.072	0.122	0.385	0.422
Hardwood	Pulpwood	85	0.071	0.122	0.385	0.422
Hardwood	Pulpwood	86	0.071	0.122	0.385	0.422
Hardwood	Pulpwood	87	0.070	0.122	0.385	0.423
Hardwood	Pulpwood	88	0.070	0.123	0.385	0.423
Hardwood	Pulpwood	89	0.069	0.123	0.385	0.424
Hardwood	Pulpwood	90	0.068	0.123	0.385	0.424
Hardwood	Pulpwood	91	0.068	0.123	0.385	0.424
Hardwood	Pulpwood	92	0.067	0.123	0.385	0.425
Hardwood	Pulpwood	93	0.067	0.124	0.385	0.425
Hardwood	Pulpwood	94	0.066	0.124	0.385	0.425
Hardwood	Pulpwood	95	0.066	0.124	0.385	0.426
Hardwood	Pulpwood	96	0.065	0.124	0.385	0.426
Hardwood	Pulpwood	97	0.065	0.124	0.385	0.426
Hardwood	Pulpwood	98	0.064	0.125	0.385	0.427
Hardwood	Pulpwood	99	0.063	0.125	0.385	0.427
Hardwood	Pulpwood	100	0.063	0.125	0.385	0.427

(End of Table 4)

**Appendix B Table 5.** Forest soil carbon accumulation tables for loblolly and/or shortleaf pine plantations established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of Carbon and short tons of Carbon. Soils data should be reported in short tons of carbon.

**AGE 1 -- 25 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
1	0.02	0.02
2	0.04	0.04
3	0.06	0.07
4	0.08	0.09
5	0.10	0.11
6	0.14	0.15
7	0.18	0.20
8	0.22	0.24
9	0.26	0.29
10	0.30	0.33
11	0.39	0.43
12	0.48	0.53
13	0.57	0.63
14	0.66	0.73
15	0.75	0.83
16	0.84	0.93
17	0.93	1.03
18	1.02	1.12
19	1.11	1.22
20	1.20	1.32
21	1.33	1.47
22	1.46	1.61
23	1.59	1.75
24	1.72	1.90
25	1.85	2.04

**AGE 26 -- 50 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
26	1.98	2.18
27	2.11	2.33
28	2.24	2.47
29	2.37	2.61
30	2.50	2.76
31	2.63	2.90
32	2.76	3.04
33	2.89	3.19
34	3.02	3.33
35	3.15	3.47
36	3.28	3.62
37	3.41	3.76
38	3.54	3.90
39	3.67	4.05
40	3.80	4.19
41	3.93	4.33
42	4.06	4.48
43	4.19	4.62
44	4.32	4.76
45	4.45	4.91
46	4.58	5.05
47	4.71	5.19
48	4.84	5.34
49	4.97	5.48
50	5.10	5.62

**Appendix B Table 6.** Forest soil carbon accumulation tables for longleaf and/or slash pine plantations established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of Carbon and short tons of Carbon. Soils data should be reported in short tons of carbon.

AGE 1 -- 25 YRS		
Age	Carbon (metric tons/ac)	Carbon (tons/ac)
1	0.02	0.02
2	0.04	0.04
3	0.06	0.07
4	0.08	0.09
5	0.10	0.11
6	0.17	0.19
7	0.24	0.26
8	0.31	0.34
9	0.38	0.42
10	0.45	0.50
11	0.58	0.64
12	0.71	0.78
13	0.84	0.93
14	0.97	1.07
15	1.10	1.21
16	1.23	1.36
17	1.36	1.50
18	1.49	1.64
19	1.62	1.79
20	1.82	2.01
21	2.02	2.23
22	2.22	2.45
23	2.42	2.67
24	2.62	2.89
25	2.82	3.11

AGE 26 -- 50 YRS		
Age	Carbon (metric tons/ac)	Carbon (tons/ac)
26	3.02	3.33
27	3.22	3.55
28	3.42	3.77
29	3.62	3.99
30	3.82	4.21
31	4.02	4.43
32	4.22	4.65
33	4.42	4.87
34	4.62	5.09
35	4.82	5.31
36	5.04	5.56
37	5.26	5.80
38	5.48	6.04
39	5.70	6.28
40	5.92	6.53
41	6.12	6.75
42	6.32	6.97
43	6.52	7.19
44	6.72	7.41
45	6.92	7.63
46	7.10	7.83
47	7.28	8.02
48	7.46	8.22
49	7.64	8.42
50	7.82	8.62

**Appendix B Table 7.** Forest soil carbon accumulation tables for oak-gum-cypress forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of Carbon and short tons of Carbon. Soils data should be reported in short tons of carbon.

**AGE 1 -- 25 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
1	0.02	0.02
2	0.04	0.04
3	0.06	0.07
4	0.08	0.09
5	0.10	0.11
6	0.21	0.23
7	0.32	0.35
8	0.43	0.47
9	0.54	0.60
10	0.65	0.72
11	0.80	0.88
12	0.95	1.05
13	1.10	1.21
14	1.25	1.38
15	1.40	1.54
16	1.62	1.79
17	1.84	2.03
18	2.06	2.27
19	2.28	2.51
20	2.50	2.76
21	2.76	3.04
22	3.02	3.33
23	3.28	3.62
24	3.54	3.90
25	3.80	4.19

**AGE 26 -- 50 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
26	4.09	4.51
27	4.38	4.83
28	4.67	5.15
29	4.96	5.47
30	5.25	5.79
31	5.56	6.13
32	5.87	6.47
33	6.18	6.81
34	6.49	7.15
35	6.80	7.50
36	7.09	7.82
37	7.38	8.14
38	7.67	8.45
39	7.96	8.77
40	8.25	9.09
41	8.54	9.41
42	8.83	9.73
43	9.12	10.05
44	9.41	10.37
45	9.70	10.69
46	9.94	10.96
47	10.18	11.22
48	10.42	11.49
49	10.66	11.75
50	10.90	12.02

**Appendix B Table 8.** Forest soil carbon accumulation table for oak-pine forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of Carbon and short tons of Carbon. Soils data should be reported in short tons of carbon.

**AGE 1 -- 25 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
1	0.02	0.02
2	0.04	0.04
3	0.06	0.07
4	0.08	0.09
5	0.10	0.11
6	0.14	0.15
7	0.18	0.20
8	0.22	0.24
9	0.26	0.29
10	0.30	0.33
11	0.37	0.41
12	0.44	0.49
13	0.51	0.56
14	0.58	0.64
15	0.65	0.72
16	0.74	0.82
17	0.83	0.91
18	0.92	1.01
19	1.01	1.11
20	1.10	1.21
21	1.19	1.31
22	1.28	1.41
23	1.37	1.51
24	1.46	1.61
25	1.55	1.71

**AGE 26 -- 50 YRS**

Age	Carbon (metric tons/ac)	Carbon (tons/ac)
26	1.66	1.83
27	1.77	1.95
28	1.88	2.07
29	1.99	2.19
30	2.1	2.31
31	2.21	2.44
32	2.32	2.56
33	2.43	2.68
34	2.54	2.80
35	2.65	2.92
36	2.78	3.06
37	2.91	3.21
38	3.04	3.35
39	3.17	3.49
40	3.3	3.64
41	3.41	3.76
42	3.52	3.88
43	3.63	4.00
44	3.74	4.12
45	3.85	4.24
46	3.96	4.37
47	4.07	4.49
48	4.18	4.61
49	4.29	4.73
50	4.4	4.85

**Appendix B Table 9.** Forest soil carbon accumulation table for oak-hickory forests established on lands in agricultural use for at least ten consecutive years prior to afforestation. Annual accumulation rates are presented in metric tons of Carbon and short tons of Carbon. Soils data should be reported in short tons of carbon.

<b>AGE 1 -- 25 YRS</b>		
<b>Age</b>	<b>Carbon (metric tons/ac)</b>	<b>Carbon (tons/ac)</b>
1	0.02	0.02
2	0.04	0.04
3	0.06	0.07
4	0.08	0.09
5	0.10	0.11
6	0.12	0.13
7	0.14	0.15
8	0.16	0.18
9	0.18	0.20
10	0.20	0.22
11	0.24	0.26
12	0.28	0.31
13	0.32	0.35
14	0.36	0.40
15	0.40	0.44
16	0.47	0.52
17	0.54	0.60
18	0.61	0.67
19	0.68	0.75
20	0.75	0.83
21	0.82	0.90
22	0.89	0.98
23	0.96	1.06
24	1.03	1.14
25	1.10	1.21

<b>AGE 26 -- 50 YRS</b>		
<b>Age</b>	<b>Carbon (metric tons/ac)</b>	<b>Carbon (tons/ac)</b>
26	1.19	1.31
27	1.28	1.41
28	1.37	1.51
29	1.46	1.61
30	1.55	1.71
31	1.64	1.81
32	1.73	1.91
33	1.82	2.01
34	1.91	2.11
35	2.00	2.20
36	2.09	2.30
37	2.18	2.40
38	2.27	2.50
39	2.36	2.60
40	2.45	2.70
41	2.54	2.80
42	2.63	2.90
43	2.72	3.00
44	2.81	3.10
45	2.90	3.20
46	2.97	3.27
47	3.04	3.35
48	3.11	3.43
49	3.18	3.51
50	3.25	3.58

# **APPENDIX C**

## **Examples and Illustrations**



## Appendix C. Project Examples

### Example 1A. Quantifying Current Carbon Stocks in Above-Ground Live Biomass Using Approved Carbon Accumulation Tables

Landowner John is interested in registering his 75-acre slash pine plantation as an afforestation project in the Georgia Carbon Sequestration Registry in 2007. The pine stand was established in 1997 on unproductive cropland located in Coffee County, Georgia. Based upon soils information, the site index of the project is 65. At the time of planting, competing vegetation was successfully controlled with herbicide. 500 trees per acre were planted. Prior to establishing the plantation, the cropland was used continuously for row crop production

The John has full legal ownership of all lands in question and owns all the carbon rights associated with the forest stand.

With the help of a local GFC forester, the John has developed a forest stewardship plan that incorporates carbon sequestration as primary management objective; however, no inventory (probability sample) as been conducted.

Since no applicable inventory data exists, current carbon stocks will be estimated by carbon accumulation tables established for use in the Registry. A stand exam is conducted by an approved project certifier in order to determine the table appropriate for the project in question. The stand exam will assess the project based upon eight criteria that, when taken together, represent a single carbon accumulation table that best reflects the forest stand.

The results of the stand exam are presented in Table 1.

**Appendix C Table 1.** Stand exam results for John's slash pine plantation.

<b>Criteria</b>	<b>Characterization</b>
Timber Type	slash pine
Stand Origin	planted field
Site Index	medium
Initial Density	low
Level of Management	Intensive
Genetic Improvement	First Generation
Physiographic Region	n/a
Thinning Condition	never thinned

The resulting characterizations from the eight criteria listed above correspond to a single carbon estimation table that provides the most accurate estimation of this 75-acre slash pine stand's current carbon stocks. The current age of the stand is 10 years (planting year: 1997, current year: 2007). A portion of this table is shown below (Table 2).

**Appendix C Table 2.** Per-acre *above-ground* carbon estimates for the slash pine stand in example 1 as determined by eight stand parameters.

Stand Age (years)	PWCarbon (tons/ac)	STCarbon (tons/ac)
5	0	0
6	0.04	0
7	0.89	0
8	2.32	0
9	3.58	0
<b>10</b>	<b>4.79</b>	<b>0</b>
11	6.42	0
12	7.82	0
13	9.12	0
14	10.43	0
15	11.74	0
16	13.03	0
17	14.29	0
18	15.52	0
19	16.69	0
20	17.68	0.14

Table 2 displays the above-ground live biomass (AGLB) carbon stocks by product class, in tons of carbon (C) for the slash pine plantation in question. At the current age (10 years, shown in bold in Table 1) the certifier determines that in the pulpwood product class (PWCarbon), the stand has 4.79 tons of carbon per acre. In the sawtimber product class (STCarbon), 0 tons of carbon are stored on the site. In order to determine total per-acre AGLB carbon stocks, the certifier sums the carbon stocks for both product classes:

$$PWCarbon_{age10} = 4.79 \text{ tons/ac}$$

$$STCarbon_{age10} = 0.0 \text{ tons/ac}$$

$$AGLB \text{ carbon stocks/ac}_{age10} = PWCarbon_{age10} + STCarbon_{age10}$$

$$AGLB \text{ Carbon Stocks/ac}_{age10} = 4.79 \text{ tons C/ac} + 0.0 \text{ tons C/ac}$$

$$AGLB \text{ Carbon Stocks/ac}_{age10} = 4.79 \text{ tons C/ac}$$

Thus, the certifier estimates the current above-ground carbon stocks for this project to be 4.79 tons per acre at the current age of 10 years. This estimate establishes the project's registration-year 2007 carbon stocks.

To estimate the total above-ground carbon stocks for the entire 75-acre project in 2007, the certifier simply multiplies the per acre estimate by the number of acres in the project estimated using Table 1. Since only one table was used to estimate the forest stand, total carbon stocks per project is computed as follows:

$$\text{Total AGLB Carbon Stocks}/\text{ac}_{\text{age}10} = 4.79 \text{ tons C/ac}$$

$$\text{Project Size} = 75 \text{ ac}$$

$$\text{Total AGLB Carbon Stocks}/\text{Project}_{\text{age}10} = \text{Total Carbon Stocks}/\text{ac}_{\text{age}10} * \text{Project Size (ac)}$$

$$\text{Total AGLB Carbon Stocks}/\text{Project}_{\text{age}10} = 4.79 \text{ tons C/ac} * 75 \text{ ac}$$

$$\text{Total AGLB Carbon Stocks}/\text{Project}_{\text{age}10} = 359.25 \text{ tons}$$

### **Example 2A: Estimating Below-Ground Live Biomass (BGLB) Carbon Stocks.**

In example 1, John estimated that in 2007 his afforestation project's above-ground live biomass carbon stocks equaled 4.79 tons of carbon per acre. In order to determine a per-acre estimate of below-ground live biomass, a standard factor of 0.25 is used.

$$\text{AGLB Carbon Stocks}/\text{ac}_{\text{age}10} = 4.79 \text{ tons C/ac}$$

$$\text{BGLB standard estimation factor} = 0.25$$

$$\text{BGLB Carbon Stocks}/\text{ac}_{\text{age}10} = \text{AGLB Carbon Stocks}/\text{ac}_{\text{age}10} * 0.25$$

$$\text{BGLB Carbon Stocks}/\text{ac}_{\text{age}10} = 1.2 \text{ tons C / ac}$$

Example 1C: Estimating Forest Soil Carbon Stocks in an Afforestation Project.

Afforestation projects are eligible to report estimates of soil carbon stocks, which are derived from default estimates that incorporate species and years since planting (refer to Part 7 for details). John's 10-year-old slash pine stand is estimated using Appendix Table 3:

**Appendix Table 3.** Regional estimates of soil carbon accumulation rates for Longleaf-Slash pine stands with afforestation of land

Age	Accumulation rate
	Tons C/ac
<b>0-5</b>	<b>0.02</b>
<b>6-10</b>	<b>0.07</b>
11-15	0.13
16-20	0.13
21-25	0.20
26-30	0.20
31-35	0.20
36-40	0.22
41-45	0.20
46-50	0.18

To determine his project's current soil carbon stocks, John must sum the annual accumulations of soil carbon since the slash pine stand was planted (1997) until the present (2007), as shown below:

Stand Age: 10 years

Annual Accumulations (Years 1 – 5) = 0.02 tons C/ac

Annual Accumulations (Years 6 – 10) = 0.07 tons C/ac

*To calculate current soil carbon stocks:*

$(0.02 \text{ tons C/ac} * 5 \text{ years}) + (0.07 \text{ tons C/ac} * 5 \text{ years}) = \mathbf{0.45 \text{ tons C/ac}}$

A summary of John's afforestation project is presented in Appendix Table 4.

**Appendix C Table 4.** Current carbon stocks for the 75 acre project's three required carbon pools. Stocks are presented per-acre and per-project. Note that only afforestation projects may report soil carbon accumulations.

Report Year	Carbon Tons Per Acre					Carbon Tons Per Project				
	AGLB	BGLB	Soils	Total	Annual Activity	AGLB	BGLB	Soils	Total	Annual Activity
2007	4.79	1.2	0.45	6.44	n/a	359.25	90	33.75	482.75	n/a

After reporting his project's current carbon stocks for each required pool, John will report his project's carbon stocks annually. The difference between 2008 carbon stocks and 2007 carbon stocks will provide an estimate of the project's annual activity for 2007.

$$\text{Annual Activity}_{2007} = (\text{Carbon Stocks}_{2008}) - (\text{Carbon Stocks}_{2007})$$

## EXAMPLE 2: FOREST MANAGEMENT PROJECT

In 2007, the Acme Timber Company plans to initiate a forest management project on 400 acres of land under its ownership in Terrell County, Georgia. A stand exam was conducted on the project lands in 2007. The project is comprised of two distinct timber types: stratum 1 is a natural 50-year old Oak-Hickory stand that is 200 acres in size; stratum 2 is a 20-year old loblolly pine plantation established on a cutover site that is 200 acres in size. The results of the stand exam are presented in Appendix Table 5 below.

**Appendix Table 5.** Stand exam results for Acme's forest management project

Criteria	Characterization	
	Stratum 1	Stratum 2
Timber Type	Oak-Hickory	Loblolly Pine
Stand Origin	Natural	Planted cutover site
Site Index	n/a	low
Initial Density	n/a	low
Level of Management	extensive	extensive
Genetic Improvement	n/a	unimproved
Physiographic Region	n/a	upper coastal plain
Thinning Condition	n/a	thinned at 15 yrs
Size (acres)	200	200
Age (years)	50	20

In order to estimate the project's total carbon stocks, each stratum must first be estimated individually using the appropriate carbon accumulation table based upon the stand

characterization shown in Appendix Table 5. The carbon accumulation tables will provide an estimate of the above-ground live biomass on a per-acre basis.

Using the calculation methods described in Example 1, Acme estimates the projects current carbon stocks for each stratum individually, as shown in Appendix Table 6. Since forest management projects are not eligible to report carbon stocks in forest soils, only above-ground and below-ground live biomass will be reported to the registry.

**Appendix Table 6.** Current carbon stocks for Acme’s 400-acre forest management project listed by stratum.

Stratum	Carbon Tons Per Acre					Carbon Tons Per Project				
	AGLB	BGLB	Soils	Total	Annual Activity	AGLB	BGLB	Soils	Total	Annual Activity
1	38.8	9.7	---	48.5	n/a	7760	1940	---	9700	n/a
2	15.4	3.85	---	19.25	n/a	3080	770	---	3850	n/a
<b>2007 Total</b>	<b>54.2</b>	<b>13.55</b>	---	<b>67.75</b>	n/a	<b>10840</b>	<b>2710</b>		<b>13550</b>	n/a

**Project Activity Page Example.**

Year	Acres	AGLB (MTCO <sub>2</sub> e)	BGLB (MTCO <sub>2</sub> e)	Soil (MTCO <sub>2</sub> e)	Products (MTCO <sub>2</sub> e)	Total Stocks (MTCO <sub>2</sub> e)	Reductions (MTCO <sub>2</sub> e)	Emissions (MTCO <sub>2</sub> e)	Cumulative Activity (MTCO <sub>2</sub> e)
2006	105.0	3533	883	128	0	4545	0	0	0
2007	105.0	4072	1018	156	0	5246	701	0	701
2008	105.0	4829	1207	183	0	6220	974	0	1675
2009	105.0	5567	1392	211	0	7169	950	0	2625
2010	105.0	6347	1587	239	0	8173	1003	0	3628
2011	105.0	7098	1774	267	0	9139	966	0	4594
2012	105.0	7817	1954	305	0	10077	938	0	5532
2013	105.0	8529	2132	351	0	11012	935	0	6467
2014	105.0	9230	2307	396	0	11933	921	0	7388

**Year**—The report year. The first year shown (2006) represents the starting report year established for this project.

**Acres**—The acres and tenths of acres within the project.

**AGLB**—Above Ground Live Biomass measured metric tons of carbon dioxide equivalent for total project acreage.

**BGLB**—Below Ground Live Biomass measured in metric tons of carbon dioxide equivalent for total project acreage.

**Soil**—Soil Organic Carbon measured in metric tons of carbon dioxide equivalent for total project acreage. Optional carbon pool; only afforestation projects on old agricultural fields may report.

**Products**—Carbon storage in forest products manufactured from timber harvested within the project boundaries, measured in metric tons of carbon dioxide equivalent.

**Total Stocks**—Carbon storage across all reported pools for each report year, measured metric tons of carbon dioxide equivalent for total project acreage.

**Reductions**—Total increases in forest carbon pools for each report year.

**Emissions**—Total decreases in forest carbon pools for each report year resulting in carbon dioxide emissions to the atmosphere

**Cumulative activity**—total carbon sequestration achieved for all report years.



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