



Carbon Credits (Carbon Farming Initiative) (Avoided Deforestation) Methodology Determination 2013¹

Carbon Credits (Carbon Farming Initiative) Act 2011

I, Yvette D'Ath, Parliamentary Secretary for Climate Change, Industry and Innovation, make this Methodology Determination under subsection 106(1) of the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Dated 23 June 2013

YVETTE D'ATH

Parliamentary Secretary for Climate Change, Industry and Innovation

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Part 1 Preliminary

1.1 Name of Determination

This Determination is the *Carbon Credits (Carbon Farming Initiative) (Avoided Deforestation) Methodology Determination 2013*.

1.2 Commencement

This Determination is taken to have come into force on 1 July 2010.

1.3 Definitions

In this Determination:

above-ground biomass means:

- (a) the stem, stump, branches, bark, seeds and foliage of a living tree; or
- (b) dead matter attached to a living tree.

Act means the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

allometric domain means the set of specific conditions under which an allometric equation is likely to apply because the assumptions that underpin the allometric equation are satisfied.

allometric equation means an equation that quantifies the allometric relationship between different dimensions of an organism.

basal area means the cross-sectional area of the stem or stems of a plant or of all plants in a stand, measured at a constant height above ground level.

below-ground biomass means living biomass of the root system.

biomass means vegetation-derived organic matter, and includes living and non-living matter.

biomass fraction means the proportion of biomass in a tree component relative to the tree of which the component is a part.

biomass residue means the estimated biomass in an area following the deforestation of the area.

biomass stock means the amount of biomass held in a native forest or part of a native forest.

biomass survey means a field-based survey of biomass.

carbon dioxide equivalent (CO₂-e) means the carbon dioxide mass equivalent of the biomass or greenhouse gas.

carbon estimation area has the meaning given by section 3.6.

carbon stock means the amount of carbon held in a native forest or part of a native forest.

CFI Mapping Guidelines means the guidelines of that name, as published from time to time, and available on the website of the department that administers the Act.

clearing means the conversion, caused by people, of native forest to a land use other than native forest.

clearing buffer has the meaning given by section 3.5.

clearing consent means approval to commence clearing required by Commonwealth, State or Territory law, issued by the relevant Commonwealth, State, Territory or local regulatory authority responsible for giving the approval.

controlled burn means the controlled application of fire within a carbon estimation area.

cropland means arable or tillable land that is used for producing annual or perennial crops.

debris pool means the biomass from trees cleared.

deforestation has the meaning given in the Regulations.

deforestation plan has the meaning given by subsection 3.12(3).

degradation means a detectable reduction in the biomass of the native forest in the project area where, notwithstanding the reduction, the area remains, or has the potential to remain, a native forest, and includes a reduction caused by management activities.

diameter at breast height means the diameter of the stem of a tree, including the bark, measured at 1.3 metres above ground level.

disturbance means:

- (a) degradation; or
- (b) natural disturbance.

exclusion area means an area of land within the project area that is not used to estimate abatement.

forest has the meaning given in the Regulations.

fuel wood means biomass collected from trees for burning.

grassland includes:

- (a) rangeland;
- (b) pasture land that is not cropland; and
- (c) vegetated land that is not a forest or native forest.

growth form means a general habit of growth of a plant determined by the direction and extent of growth, and any branching of the main-shoot axis or axes and includes: subshrub; mallee; shrub; and woody vine.

IBRA bioregion means a region described in the latest version of the Interim Biogeographic Regionalisation for Australia published by the department that administers the *Environment Protection and Biodiversity Conservation Act 1999*.

irregular feature has the meaning given by section 3.2.

land cover assessment means an analysis of remotely-sensed imagery.

Major Vegetation Group means a category of vegetation described in the National Vegetation Information System published by the department that administers the *Environment Protection and Biodiversity Conservation Act 1999*.

National Inventory System means the national inventory of greenhouse gas emissions published by the department that administers the *National Greenhouse and Energy Reporting Act 2007*.

NGER Regulations means the *National Greenhouse and Energy Reporting Regulations 2008*.

non-project tree means a tree in a carbon estimation area that, under the deforestation plan, must not be cleared.

non-project tree buffer means the proportion of non-project tree biomass to tree biomass in a carbon estimation area.

pool means relevant carbon pool or debris pool.

project commencement means the day on which the declaration in relation to the project under subsection 27(2) of the Act takes effect.

project mechanism has the meaning given by section 2.5.

pseudo-random number generator means computer software used for generating a sequence of numbers that approximates the properties of random numbers.

raster means, for a map, the division of the map into a grid of pixels that can be coded according to characteristics of, or relating to, the area represented by the pixel.

Regulations means the *Carbon Credits (Carbon Farming Initiative) Regulations 2011*.

relevant carbon pool has the meaning given by sections 3.39 and 3.47.

residual means the deviation of one of a set of observations or numbers from the mean of a set.

root:shoot ratio means the ratio of below-ground biomass to above-ground biomass.

seed number means a number input into a pseudo-random number generator for the purposes of generating a sequence of numbers that approximates the properties of random numbers.

shrub means a living plant with a stem diameter of less than 50 millimetres at a height of 1.3 metres.

stratification means the division of the project area into strata in accordance with Division 3.2.

stratum means:

- (a) a carbon estimation area;
- (b) an exclusion area; or

(c) a clearing buffer.

Targeted Precision has the meaning given by section 3.32.

thinning means the selective removal of trees from native forest, where the removal does not:

- (a) amount to clearing; or
- (b) result in a reduction of estimated abatement below that already credited under the Determination.

tree has the meaning given in the Regulations.

vector means a coordinate-based spatial data layer that represents geographic features as points, lines, and polygons.

wildfire means a fire that is not a controlled burn.

Note Other words and expressions used in this Determination have the meaning given by the Act. These terms include:

Australian carbon credit unit

baseline

crediting period

eligible offsets project

emission

greenhouse gas

native forest

native forest protection project

natural disturbance

offsets project

offsets report

project

project area

project proponent

Regulator

reporting period

1.4 Kind of project to which this Determination applies

Note: See paragraph 106(1)(a) of the Act.

This Determination applies to a project that is a native forest protection project.

Part 2 Requirements for declaration as eligible project

Note See paragraphs 27(4)(c) and 106(1)(b) of the Act.

2.1 Eligible projects

To be declared an eligible offsets project, a project to which this Determination applies must meet the requirements in this Part.

2.2 Location

The project area must be within Australia, including external territories.

2.3 Project area native forest

The project area must include native forest:

- (a) that was native forest on 31 December 1989;
- (b) that was native forest at all times between 1 January 1990 and project commencement;
- (c) for which there is clearing consent that:
 - (i) was issued before 1 July 2010;
 - (ii) provides that clearing is permitted for the purpose of converting the native forest to cropland or grassland;
 - (iii) does not provide that clearing is permitted for the purpose of converting the native forest to plantation or settlements; and
 - (iv) provides that the conversion of the native forest to cropland or grassland must be maintained in perpetuity;
- (d) from which removal of wood for the purposes of creating timber or wood products is not authorised by law; and
- (e) for which there is no permit for the collection of fuel wood.

2.4 Evidence relating to project area native forest

- (1) An application under subsection 22(1) of the Act for a declaration of an eligible offsets project to which this Determination applies must be accompanied by evidence as provided by this section.
- (2) In relation to paragraph 2.3(a) the project proponent must provide:
 - (a) National Inventory System forest cover layer data expressed in a vector or raster array in relation to the project area in 1989; or
 - (b) aerial or remotely-sensed imagery of the project area produced in 1989.
- (3) In relation to paragraph 2.3(b) the project proponent must provide:

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- (a) the most recent National Inventory System forest cover layer data expressed in a vector or raster array in relation to the project area; or
 - (b) aerial or remotely-sensed imagery of the project area produced no later than one year before the day on which an application under subsection 22(1) of the Act is made.
- (4) In relation to paragraph 2.3(c) the project proponent must provide a copy of the clearing consent.

2.5 Project mechanism

- (1) The project must protect the native forest mentioned in section 2.3.
- (2) For the purposes of subsection (1) the project proponent must:
- (a) not clear the native forest mentioned in section 2.3; and
 - (b) manage the native forest mentioned in section 2.3 in order to achieve a mix of native trees, shrubs and understorey species.

Native forest vegetation mix

- (3) The mix mentioned in paragraph (2)(b) must reflect the structure and composition of the vegetation community in a national park, flora reserve, or state forest within the IBRA bioregion in which the project area is situated.
- (4) If the IBRA bioregion in which the project area is situated does not contain a national park, flora reserve or state forest, then the mix mentioned in paragraph (2)(b) must reflect the structure and composition of the vegetation community in a native forest in the IBRA bioregion.
- (5) The vegetation community mentioned in subsection (3) may be a monoculture if a monoculture can naturally occur within the IBRA bioregion in which the project area is situated.

2.6 Project commencement

- (1) If the project proponent wishes the project to be backdated, the project proponent must provide the Regulator with evidence that, before submitting an application under subsection 22(1) of the Act, the project proponent met the requirements set out in section 2.5.

Note Under subsection 27(15) of the Act, a declaration of an eligible offsets project takes effect when an application for a declaration is made or on an earlier day specified in the declaration, provided that the specified day is not earlier than 1 July 2010.

- (2) The evidence in subsection (1) must include:
- (a) evidence of activities in the project area that:
 - (i) assisted native forest management; or
 - (ii) contributed to native forest protection; or
 - (b) evidence of activities in the project area to estimate carbon stocks; or

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- (c) registration of carbon property rights under state or territory carbon rights legislation; or
 - (d) other evidence indicating an intention not to clear the native forest mentioned in section 2.3 in accordance with the clearing consent mentioned in paragraph 2.3(c).

Part 3 Requirements for operation of eligible projects

Note See paragraphs 27(4)(c), 35(2)(a) and 106(1)(b) of the Act and regulation 3.26 of the Regulations.

Division 3.1 Operation of eligible projects

An eligible offsets project to which this Determination applies must be operated in accordance with this Part.

Division 3.2 Stratification

3.1 Stratification

Before the submission of the first offsets report, the project area must be stratified as set out in this Division.

3.2 Remotely-sensed imagery of project area

- (1) Remotely-sensed imagery of the project area must be acquired for the purposes of stratification or re-stratification.
- (2) The remotely-sensed imagery must be consistent with the requirements of the CFI Mapping Guidelines.
- (3) The remotely-sensed imagery must be pre-processed in order to correct any *irregular feature*.
- (4) For the purposes of this section, irregular features include:
 - (a) cloud cover;
 - (b) shadows;
 - (c) geometric distortions;
 - (d) radiometric distortions; and
 - (e) sensor errors.
- (5) If an irregular feature comprising more than 10% of the area in which the project mechanism is to be implemented is detected:
 - (a) the irregular feature must be deleted; and
 - (b) the remotely-sensed imagery must be filled from the same imagery source within the nearest possible data range.

3.3 Land-cover assessment

- (1) For the purposes of stratification or re-stratification, a land-cover assessment using the remotely-sensed imagery mentioned in section 3.2 must be performed in accordance with subsection (2) of this section.

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- (2) The remotely-sensed imagery must be examined and each feature must be classified as:
 - (a) an area in which the project mechanism will be implemented;
 - (b) an area in which the project mechanism will not be implemented; or
 - (c) an area of native forest in which disturbance has occurred.
 - (3) Paragraph (2)(c) does not apply in relation to the stratification undertaken before submission of the first offsets report.

3.4 Requirements for an exclusion area

An exclusion area must be delineated:

- (a) for any area of land within the project area that is:
 - (i) not a clearing buffer; and
 - (ii) an area in which the project mechanism will not be implemented; and
- (b) in accordance with the CFI Mapping Guidelines.

3.5 Clearing buffers

- (1) If the clearing consent mentioned in paragraph 2.3(c) provides that an area of the native forest mentioned in section 2.3 may not be cleared, at least one clearing buffer must be included in the project area.
- (2) A clearing buffer must cover an area of the native forest mentioned in section 2.3.
- (3) A clearing buffer must not cover an area of native forest that is in an exclusion area.
- (4) The clearing buffer or clearing buffers must have a total area equivalent to the area of native forest that may not be cleared under the clearing consent mentioned in paragraph 2.3(c).
- (5) To avoid doubt, a clearing buffer is not an exclusion area or a carbon estimation area.
- (6) The project mechanism must be implemented in each clearing buffer.

3.6 Requirements for a carbon estimation area

Each carbon estimation area must be:

- (a) an area where the project mechanism is to be implemented;
- (b) within the project area;
- (c) an area of native forest that is not delineated as an exclusion area in accordance with section 3.4; and
- (d) an area of native forest that is not delineated as a clearing buffer in accordance with section 3.5.

3.7 Re-stratification of carbon estimation areas

- (1) This section applies to each carbon estimation area in which:
 - (a) disturbance has been detected;
 - (b) the disturbance has resulted in a crown cover loss of more than 5% over an area larger than 50 hectares or 5% of the project area; and
 - (c) the disturbance has not previously been re-stratified.
- (2) Before the next offsets report following the detection of the disturbance, the spatial extent of the disturbance must be delineated as a new carbon estimation area.
- (3) Any carbon estimation area the boundary of which encloses or is crossed by the carbon estimation area in subsection (2) must be re-stratified to exclude the carbon estimation area in subsection (2) before the next offsets report following the detection of the disturbance.

3.8 Strata boundaries

- (1) The geographic boundaries of each stratum within the project area must be identified on a geospatial map in accordance with the CFI Mapping Guidelines.
- (2) The map mentioned in subsection (1) must be submitted with the first offsets report that is submitted to the Regulator.
- (3) If a carbon estimation area is re-stratified, the map mentioned in subsection (1) must be:
 - (a) amended to show the new strata boundaries; and
 - (b) included with the next offsets report that is submitted to the Regulator.

Division 3.3 Restrictions on activities

3.9 No commercial harvesting

No biomass may be removed from a carbon estimation area or clearing buffer for commercial purposes.

3.10 Fuel wood, fencing and thinning

The following are permitted in carbon estimation areas and clearing buffers:

- (a) removal of fuel wood for personal use, provided that no more than 5% of carbon stocks from the carbon estimation area or clearing buffer are removed;
- (b) removal of wood for the purposes of erecting or repairing fences, provided that no more than 5% of carbon stocks from the carbon estimation area or clearing buffer are removed; and
- (c) thinning of biomass for the purposes of:
 - (i) promoting biodiversity; or

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- (ii) enhancing carbon stocks;
provided that 95% of the biomass thinned remains as dead wood within the carbon estimation area or clearing buffer in which it was thinned.

Division 3.4 Calculations

Subdivision 3.4.1 Baseline

3.11 Baseline

For the purposes of paragraph 106(4)(f) of the Act, the baseline for the offsets project is the carbon stocks in the carbon estimation areas if the deforestation plan had been implemented, calculated in accordance with Equation 27 in section 3.45.

Note See section 107 of the Act.

3.12 Recording baseline activities—deforestation plan

- (1) A deforestation plan must be prepared in relation to the project area.
- (2) For the purposes of this Determination, the deforestation plan records the baseline activities.
- (3) The *deforestation plan* must identify:
 - (a) the spatial extent of the project area;
 - (b) the spatial extent of the native forest in the project area;
 - (c) the spatial extent of the native forest authorised by the clearing consent mentioned in paragraph 2.3(c) to be cleared;
 - (d) the spatial extent of any part of the native forest not authorised by the clearing consent mentioned in paragraph 2.3(c) to be cleared;
 - (e) the spatial extent of any part of the native forest in relation to which clearing is not possible or practicable;
 - (f) the spatial extent of each carbon estimation area;
 - (g) the spatial extent of each clearing buffer;
 - (h) each proposed land use following clearing in accordance with the clearing consent mentioned in paragraph 2.3(c);
 - (i) the spatial extent of each proposed land use following clearing in accordance with the clearing consent mentioned in paragraph 2.3(c); and
 - (j) any requirement, whether in accordance with the clearing consent mentioned in paragraph 2.3(c) or otherwise, to maintain non-project trees.
- (4) The deforestation plan must include a map prepared in accordance with the CFI Mapping Guidelines depicting the spatial information in subsection (3).

Subdivision 3.4.2 Allometric equations

3.13 Allometric equations to be validated or developed

In relation to each tree species or group of species in the project area measured as part of the biomass survey undertaken in accordance with Subdivision 3.4.3, the project proponent must:

- (a) develop and validate a new equation for each species or group of species measured in the biomass survey in accordance with Subdivision 3.4.3; or
- (b) validate an existing allometric equation in accordance with section 3.25, provided:
 - (i) the allometric equation has been published in a peer-reviewed journal as a valid allometric equation;
 - (ii) the allometric equation was developed using a dataset of more than 15 trees;
 - (iii) the allometric domain is known;
 - (iv) the allometric domain is consistent with the carbon estimation area to which the allometric equation is to be applied; and
 - (v) the measurement protocols for the allometric equation are known and are consistently applied; or
- (c) validate an allometric equation developed in accordance with this Determination for another offsets project.

3.14 Validating or developing allometric equations

Each allometric equation must be validated or developed using destructive sampling by carrying out the steps specified in this Subdivision.

3.15 Step 1—Scope of allometry

- (1) Allometric equations developed or validated in accordance with this Subdivision apply only to the above-ground biomass of the native forest in the project area.

Note The below-ground biomass of the native forest in the project area is determined using root:shoot ratios as provided by section 3.28.

- (2) The use of an allometric equation is restricted to its allometric domain as defined in section 3.16.

3.16 Step 2—Determination of allometric domains

- (1) An allometric domain describes the specific conditions under which an allometric equation is likely to apply because the assumptions that underpin the allometric equation are satisfied.
- (2) Allometric domains must be determined in accordance with the requirements of this section.

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- (3) For each allometric equation that is to be developed or validated, the following must be defined:
 - (a) a unique identifier and reference;
 - (b) the species or group of species for which the allometric equation has been or will be developed;
 - (c) the species growth form for which the allometric equation has been or will be developed; and
 - (d) the range of values of measurements for each variable used to develop the allometric equation.
 - (4) If a new allometric equation is to be developed, the allometric domain must include the spatial extent in which the allometric equation applies.
 - (5) If a pre-existing allometric equation is to be validated, the allometric domain must include the spatial extent in which the allometric equation applies if the spatial extent is defined.
 - (6) If an allometric equation is developed in respect of a group of species:
 - (a) the growth form of each species to which the allometric equation applies must be the same; and
 - (b) each species must be identified prior to the commencement of destructive sampling as provided by this Subdivision; and
 - (c) individual trees in the group of species must be selected independently of their species for destructive sampling.

3.17 Step 3—Sample size

- (1) For each allometric equation to be validated, at least 6 trees must be selected for destructive sampling, including at least one tree from each class size as defined in section 3.21.
- (2) For each new allometric equation to be developed, at least 20 trees must be selected for destructive sampling, including at least one tree from each class size as defined in section 3.21.

3.18 Step 4—Determination of plot design for tree selection

- (1) The plot design for tree selection must be determined in accordance with section 3.29.
- (2) Enough plots must be allocated to capture at least 100 trees across the area mentioned in subsection 3.19(1).

3.19 Step 5—Allocation of plots for tree selection

- (1) When developing an allometric equation, plots for tree selection must be allocated within:
 - (a) one or more carbon estimation areas; and

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- (b) the spatial extent of each allometric domain as defined in section 3.16.
 - (2) When validating an allometric equation, plots for tree selection must be allocated across the carbon estimation area or areas in which the allometric equation is to be applied.
 - (3) Waypoints for plot locations within the areas mentioned in subsection (1) or (2) must be allocated using a pseudo-random number generator with a known seed number.

3.20 Step 6—Survey and random selection of trees for destructive sampling

- (1) Waypoints must be established using a GPS device with an accuracy of at least ± 4 metres.
- (2) A plot at each waypoint must be established as provided by section 3.18.
- (3) A unique identifier must be assigned to each tree within each plot.
- (4) For each tree, each variable to be used in an allometric equation must be measured.
- (5) Enough plots to achieve the sample size prescribed in section 3.18 must be established.

3.21 Step 7—Size classes

- (1) The trees mentioned in section 3.20 must be:
 - (a) classified according to the species or group of species for which an allometric equation is to be developed; and
 - (b) further classified into at least 3 size classes per species or group of species mentioned in paragraph (a).
- (2) Each size class must have:
 - (a) a minimum range identifying the smallest variable for tree selection;
 - (b) a maximum range identifying the largest variable for tree selection; and
 - (c) a defined class size interval.
- (3) Use a pseudo-random number generator with a known seed number to rank the trees mentioned in subsection (1) within the class sizes mentioned in subsection (2).
- (4) At least the first tree in each class size ranked in accordance with subsection (3) must be selected for destructive sampling in accordance with section 3.22.
- (5) If more than one tree per class size is needed to achieve the sample size specified in section 3.17:
 - (a) trees must be selected sequentially according to the ranking in subsection (3); or
 - (b) the trees with the maximum or minimum variable in relation to each size class must be selected.

3.22 Step 8—Destructive sampling procedure

Step 8.1—Wet weight of sample trees

- (1) Each sample tree selected in section 3.21 must be cut down at ground level.
- (2) The wet weight of each tree mentioned in subsection (1) must be measured.

Note Trees may be cut into smaller parts for the purposes of measuring their wet weight.

Step 8.2—Allometric equations for single species

- (3) If an allometric equation is to be developed for a single species:
 - (a) then the following must be selected:
 - (i) at least every third tree cut down in accordance with subsection (1) in the order of cutting; and
 - (ii) at least one tree from each class size mentioned in section 3.20; and
 - (b) each tree selected in accordance with paragraph (a) must be cut into its component parts.
- (4) For the purposes of this section, component parts include:
 - (a) stem;
 - (b) branches;
 - (c) crown; and
 - (d) dead material, including dead branches, dead stem and dead crown, attached to the sample tree.
- (5) The trees mentioned in subsection (3) must have been cut down within a 30 day period.
- (6) Subsection (5) does not apply if each tree mentioned in subsection (1) has been analysed in accordance with section 3.23.

Step 8.3—Allometric equations for groups of species

- (7) If an allometric equation is to be developed for a group of species, each of the trees cut down in accordance with subsection (1) must be cut into component parts in accordance with subsection (4).

3.23 Step 9—Biomass analysis

- (1) For each tree cut into components in accordance with subsection 3.22:
 - (a) the weight of each component mentioned in subsection 3.22(3) or 3.22(7) must be recorded.
 - (b) at least 3 representative subsamples must be cut from each component mentioned in subsections 3.22(3) or 3.22(7).
 - (c) the weight of each subsample mentioned in paragraph (b) must be immediately recorded in order to determine the wet weight of the subsample.

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- (d) each subsample mentioned in paragraph (b) must be dried in an oven with a temperature between 70 and 80 degrees Celsius until the subsample has achieved a constant weight.
 - (e) when the subsamples mentioned in paragraph (b) have achieved a constant weight, the weight of each subsample must be recorded in order to determine the dry weight of the subsample.
 - (f) the dry to wet weight ratio for each component mentioned in subsection 3.22(3) or 3.22(7) must be estimated by dividing the dry weight of the subsample determined in paragraph (e) by the subsample wet weight determined in paragraph (c).
 - (g) the dry weight of each component mentioned in subsections 3.22(3) and 3.22(7) must be estimated by multiplying the component weight determined in paragraph (a) by the average of the corresponding dry to wet weight ratio for that component for the sample tree estimated in paragraph (f).
 - (h) the dry weight of each sample tree mentioned in subsection 3.22(3) or 3.22(7) must be estimated by summing dry weight of each component estimated in paragraph (g) for each sample tree.
- (2) For each tree analysed in accordance with subsection (1), the whole tree dry to wet weight ratio must be estimated by dividing the tree dry weight measured in accordance with subsection 3.22(2) by the tree wet weight estimated in paragraph (1)(h).
 - (3) If:
 - (a) an allometric equation is to be developed for a single species; and
 - (b) each of the trees cut down in accordance with subsection 3.22(1) was not analysed in accordance with this section;the coefficient of variation of tree dry to wet weight ratio must be estimated by dividing the standard deviation of tree dry to wet weight ratio by its average.
 - (4) If the coefficient of variation estimated in accordance with subsection (3) exceeds 15%:
 - (a) all measurements associated with trees not analysed in accordance with this section must be discarded;
 - (b) destructive sampling for the equivalent number of sample trees discarded in accordance with paragraph (a) must be repeated in accordance with subsection 3.22(1); and
 - (c) analysis of the sample trees must be completed in accordance with this section.
 - (5) If the coefficient of variation calculated in accordance with subsection (3) is equal to or less than 15%, the dry weight of any sample trees not analysed in accordance with this section must be estimated by multiplying the tree wet weight by the average tree dry to wet weight ratio.

3.24 Step 10—Data exploration and analysis

- (1) The whole tree dry weight data obtained in section 3.23 must be compiled into a database or spreadsheet suitable for statistical analysis or importation into a statistical analysis software package.
- (2) If an existing allometric equation is to be validated, Step 10.1 in this section must be skipped and Step 11 in section 3.25 must be completed.
- (3) If a new allometric equation is to be validated, Step 10.1 in this section must be completed.

Step 10.1—Allometric development

- (4) An allometric equation being developed must take the form of a statistical model fitted using:
 - (a) simple linear regression;
 - (b) multiple regression;
 - (c) polynomial regression; or
 - (d) non-linear regression.
- (5) Each allometric equation developed must satisfy the assumptions that:
 - (a) the means of the response variables change in a systematic way with variation in the explanatory variable; and
 - (b) errors are:
 - (i) independent; and
 - (ii) normally distributed.
- (6) To satisfy the assumptions in subsection (5), data may be transformed.
- (7) If data is transformed as permitted by subsection (6), power transformations may be used.
- (8) If a logarithmic transformation is applied to the response variable, the proportional bias must be estimated and applied using the ratio of the arithmetic sample mean to the mean of the back-transformed predicted variables.
- (9) Each explanatory variable used in an allometric equation must be statistically significant.
- (10) For the purposes of subsection (9), a variable is statistically significant if the outcome of an F-test or a two-tailed t-test has a probability value of less than 5%.
- (11) Each allometric equation developed must be verified by comparing the statistical model's predictions with observations of trees mentioned in subsection (1).
- (12) The mean of the weighted residuals for the observed and predicted biomass estimates of the dataset of trees used to derive the allometric equation must be computed by completing Equation 1 and Equation 2.

$WR_{j,md} = w_{j,md} (B_{j,md} - PB_{j,md})$	Equation 1
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Where:

- $WR_{j,md}$ = weighted residual (kilograms) for tree (j,md).
 j,md = a test tree (j) from the data set (md) used to derive the allometric equation.
 $B_{j,md}$ = observed biomass (kilograms) for tree (j,md) measured by destructive sampling.
 $PB_{j,md}$ = biomass (kilograms) for tree (j,md) predicted from the allometric equation.
 $w_{j,md}$ = weighting factor applied to tree (j,md) calculated in accordance with Equation 2.

$w_{j,md} = \frac{1}{(BA_{j,md})^{0.5}}$	Equation 2
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Where:

- $w_{j,md}$ = weighting factor applied to tree (j,md).
 $BA_{j,md}$ = basal area of tree (j,md) (square metres).
 j,md = a test tree (j) from the data set (md) used to derive the allometric equation.

- (13) The mean of the weighted residuals calculated in Equation 1 must not be significantly different from zero, as determined by applying a two-tailed student t-test where $\alpha = 0.05$.
- (14) If the model satisfies subsection (13), proceed to Step 11 in section 3.25.
- (15) If the model does not satisfy subsection (13):
- (a) an existing equation must be selected in accordance with section 3.13 and validated using the procedure outlined in section 3.25; or
 - (b) a new equation must be developed following the procedure outlined in this Subdivision.

3.25 Step 11—Validation of allometric equation

- (1) Each allometric equation must be validated in respect of the area to which the clearing consent mentioned in section 2.3 applies.
- (2) Each allometric equation must be validated in:
 - (a) the first reporting period; and
 - (b) the last reporting period in the crediting period.

Step 11.1—Confirmation of allometric domain

- (3) Once a biomass survey has been completed in accordance with Subdivision 3.4.3, an allometric domain must be confirmed in accordance with this section for each model to be applied.
- (4) Before applying a model, the project proponent must confirm that the characteristics of the species or group of species whose biomass is to be predicted fall within a valid allometric domain as defined in section 3.16.
- (5) For trees measured in the biomass survey, a table must be prepared listing:
 - (a) the species of tree(s);
 - (b) the species growth form;
 - (c) the spatial extent of the species; and
 - (d) the range of values of all explanatory variables measured.
- (6) The information collated in the table mentioned in subsection (5) must fall within the range of values described by the dataset used to develop the allometric equation.
- (7) Trees that do not fall within the allometric domain must be excluded from the results of the biomass survey.

Step 11.2—Predicted biomass of sample trees

- (8) An estimate of the biomass contained within each sample tree must be predicted using the allometric equation to be validated in accordance with section 3.17.
- (9) For the purposes of subsection (8), the explanatory variable measurements collected for each test tree must be used as inputs.

Step 11.3—Comparison between predicted and observed biomass

- (10) The validity of each model for prediction must be established by comparing its predictions with observed values estimated by the destructive sampling of trees selected in accordance with sections 3.17 to 3.23.
- (11) Destructively sampled trees used for the validation of an allometric equation must not have been included in the development of the allometric equation.
- (12) The mean of weighted residuals for the observed and predicted biomass estimates of the set of test trees generated in accordance with Step 11.2 in this section must be computed using Equation 3 and Equation 4.

$WR_j = w_j(B_j - PB_j)$	Equation 3
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Where:

- WR_j = weighted residual in kilograms (kg) for tree (j).
 j = a test tree from a dataset not used to derive the allometric equation.
 B_j = biomass (kilograms) for tree (j) measured through destructive sampling.

PB_j = biomass (kilograms) for tree (j) predicted from the allometric equation.

w_j = weighting factor applied to tree (j) calculated in accordance with Equation 4.

$w_j = \frac{1}{(BA_j)^{0.5}}$	Equation 4
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Where:

w_j = weighting factor applied to tree (j).

BA_j = basal area (square metres) of tree (j).

j = a test tree from a dataset not used to derive the allometric equation.

Step 11.4—Minimum requirements for validation of allometric equations

- (13) An allometric equation is validated and may be applied only if:
- (a) the characteristics of the species or group of species, the biomass of which is to be predicted, fall within the valid domain of the allometric function to be applied, in accordance with Step 11.1 in this section; and
 - (b) the mean of the weighted residuals calculated by applying Equation 3 is not significantly different from zero, as determined by applying a two-tailed student t-test where $\alpha = 0.05$.

3.26 Procedure if allometric equation cannot be validated

If an allometric equation cannot be validated:

- (a) select another equation to validate in accordance with section 3.13; or
- (b) develop a new equation in accordance with section 3.24.

Subdivision 3.4.3 Biomass survey

3.27 Determination of native forest biomass

- (1) A field-based survey must be undertaken by following the steps in this Subdivision in order to determine the biomass stocks in the native forest in each carbon estimation area.
- (2) A biomass survey must be undertaken for all carbon estimation areas within 6 months of the submission of the first offsets report for the project.
- (3) If no disturbance has been detected in a carbon estimation area:
 - (a) the values reported in respect of the carbon estimation area in the most recent offsets report may be reported; and
 - (b) no further biomass survey must be undertaken.

3.28 Determination of root:shoot ratios

In order to determine the root:shoot ratio in Equation 8 and Equation 14:

- (a) the Major Vegetation Group class in which plot (sp) is located must be identified; and
- (b) the root:shoot ratio for the class in paragraph (a) must be selected as specified in Schedule 1.

3.29 Step 1—Plot design

- (1) A plot design must be selected in accordance with this section.
- (2) Each plot in a carbon estimation area must:
 - (a) have a fixed orthogonal area and shape with a definite spatial boundary;
 - (b) be able to be re-established for auditing purposes;
 - (c) be circular, square or rectangular; and
 - (d) have an area equal to or greater than 0.05 hectares.
- (3) If the plot is circular, the plot waypoint is the centre of the circle and the plot must be established around the waypoint.
- (4) If the plot is square or rectangular, the plot waypoint is the south-west corner of the plot and the plot must be oriented along a north-south axis.
- (5) If the plot is located on a slope greater than 10 degrees, then a correction must be applied in order to achieve a constant orthogonal area.
- (6) The plot design selected in accordance with this section must be used for each biomass survey conducted for the purposes of this Determination.

3.30 Step 2—Allocation of plots

- (1) At least 200 waypoints must be assigned to each carbon estimation area in accordance with subsection (2).
- (2) A pseudo-random number generator must be used with a defined seed number in order to allocate plot points to each carbon estimation area.
- (3) The plot points obtained in subsection (2) are the waypoints of the plots.
- (4) A pseudo-random generator with a known seed value must be used to assign a different number to each waypoint.
- (5) The numbers assigned as provided by subsection (4) must be ranked from lowest to highest.
- (6) The lowest ranked plot in subsection (5) is *plot 1* and the highest ranked is equal to the number of waypoints assigned in subsection (1).
- (7) For the purposes of a biomass survey, all the plots ranked from 1 until the number of plots obtained in Step 4.2 in section 3.32 must be surveyed.

-
- (8) The area boundary used to allocate plots as provided by this section must be retained in order to enable the replication of the plot allocation using the defined seed number.
 - (9) Attributes for each plot waypoint must be assigned, including:
 - (a) the project name [NAME];
 - (b) the carbon estimation area number to which points are allocated [CEA_NUM];
 - (c) the plot point number [PLOT_NUM];
 - (d) the X coordinate in decimal degrees [X_VALUE];
 - (e) the Y coordinate in decimal degrees [Y_VALUE]; and
 - (f) the date of allocation points to the carbon estimation area [DATE_REG].

3.31 Step 3—Pilot survey

- (1) For each carbon estimation area, a pilot survey must be undertaken in order to perform a pre-biomass survey estimate of variance in relation to each carbon estimation area.
- (2) In order to undertake a pilot survey:
 - (a) at least the first 5 plot points allocated in accordance with section 3.30 must be surveyed; and
 - (b) a biomass survey must be undertaken in accordance with sections 3.33 and 3.34.
- (3) Data collected as part of the pilot survey may be used in order to determine the biomass of plots as provided by section 3.35.

3.32 Step 4—Number of plots

- (1) In order to determine the final sample size required to estimate carbon stocks in the native forest in the project area, Steps 4.1 and 4.2 in this section must be completed in relation to each carbon estimation area.

Step 4.1—Coefficient of variation of each carbon estimation area

- (2) The data from the pilot survey undertaken in accordance with section 3.31 must be used when completing Step 4.1.
- (3) In order to determine the population coefficient of variation within each carbon estimation area, the following formula must be completed:

$CV_i = \left(\frac{S_{\text{prelim}}}{\bar{x}_{\text{prelim}}} \right) \times 100$	Equation 5
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Where:

CV_i = coefficient of variation of pilot sample in carbon estimation area.

$s_{\text{prelim},i}$ = sample standard deviation from pilot data in carbon estimation area (tonnes of biomass).

$\bar{x}_{\text{prelim},i}$ = sample mean from pilot data in carbon estimation area (tonnes of biomass).

Step 4.2—Number of plots to sample in each carbon estimation area

- (4) For the purposes of this Determination, carbon stocks for each carbon estimation area must be estimated within $\pm 10\%$ of the true value of the mean at a 90% confidence level.
- (5) In this Determination, the requirement in subsection (4) is referred to as the **Targeted Precision**.
- (6) In order to estimate the required sample size to achieve the Targeted Precision in each carbon estimation area, the following formula must be completed:

$n_i = \frac{CV_i^2 \times t_{\text{val}}^2}{E^2}$	Equation 6
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Where:

n_i = estimated number of sample plots required to meet Targeted Precision in carbon estimation area (i).

CV_i = coefficient of variation in pilot data as calculated in Equation 5 (expressed as a percentage).

t_{val} = two-sided students t-value, at the degree of freedom equal to (n-1) where (n) is the number of plots established in the biomass survey in each carbon estimation area, for a 90% confidence level.

E = allowable level of sampling error (expressed as a percentage and fixed as 10%).

3.33 Step 5—Preparation of biomass survey

In order to ensure accuracy in measurements and to minimise error, for each carbon estimation area:

- (a) the required measures to be surveyed must be identified for all allometric equations used in the project area in accordance with Subdivision 3.4.2;
- (b) each plot that must be surveyed must be identified; and

Note These will be the plots identified in Step 2 numbering from *plot 1* through to *plot n_i* .

- (c) a survey protocol that states the requirements and processes of the biomass survey must be developed, including for the checking and calibration of measuring equipment.

3.34 Step 6—Measurements within plots

- (1) Waypoints must be established using a GPS device with an accuracy of at least ± 4 metres.
- (2) A plot at each waypoint must be established as provided by section 3.29.
- (3) The explanatory variables identified in section 3.33 must be measured in each plot established in accordance with subsection (2).
- (4) For the purposes of subsection (3), each explanatory variable required by the allometric equation applicable to each species or group of species within the plot must be measured.

3.35 Step 7—Biomass of plots

- (1) The biomass of each plot surveyed as provided by section 3.34 must be determined in accordance with Steps 7.1 to 7.4.

Step 7.1—Determination of above-ground biomass by applying allometric equations

- (2) The measurements made in the field sample plots as provided by section 3.34 must be converted into above-ground biomass stock estimates for each tree.
- (3) For the purposes of the conversion in subsection (2), the allometric equation obtained in Subdivision 3.4.2 applicable to the species or group of species to which the tree belongs must be used.
- (4) The output of the conversion in subsection (2) is $AB_{j,sp,i,r}$ where:

$AB_{j,sp,i,r}$ = above-ground biomass of tree (j) in sample plot (sp) in carbon estimation area (i) for reporting period (r) estimated based on direct non-destructive measures of explanatory variables using allometric equation applicable to tree (j) (tonnes of biomass per tree).

j = the jth tree in sample plot (sp) in carbon estimation area (i) for reporting period (r).

sp = the spth sample plot in each carbon estimation area.

i = the ith carbon estimation area.

r = the rth reporting period.

Step 7.2—Determination of above-ground biomass in survey plots

- (5) The above-ground biomass stock in survey plot (sp) in carbon estimation area (i) must be determined using the following formula:

$AB_{sp,i,r} = \sum_{j=1} AB_{j,sp,i,r}$	Equation 7
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Where:

$AB_{sp,i,r}$ = total above-ground biomass of all trees in sample plot (sp) in carbon estimation area (i) for reporting period (r) (tonnes of dry matter).

$AB_{j,sp,i,r}$ = above-ground biomass of tree (j) in sample plot (sp) in carbon estimation area (i) for reporting period (r) (tonnes of biomass per tree).

j = the jth tree in sample plot (sp) in carbon estimation area (i) at time (t).

sp = the spth sample plot in each carbon estimation area.

i = the ith carbon estimation area.

r = the rth reporting period.

Step 7.3—Determination of below-ground tree biomass in survey plots

- (6) The below-ground tree biomass in each plot surveyed as provided by Step 6 in section 3.34 must be determined using the following formula:

$BB_{sp,i,r} = RSR \times AB_{sp,i,r}$	Equation 8
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Where:

$BB_{sp,i,t}$ = total below-ground tree biomass stock of trees in plot (sp), in carbon estimation area (i) for reporting period (r) (tonnes of dry matter).

$AB_{sp,i,t}$ = total above-ground tree biomass stock of trees in plot (sp) in carbon estimation area (i) for reporting period (r) (tonnes of dry matter).

RSR = root:shoot ratio determined in accordance with section 3.28 (tonnes of root biomass per tonnes of shoot biomass).

sp = the spth sample plot in each carbon estimation area.

i = the ith carbon estimation area.

r = the rth reporting period.

Step 7.4—Determination of total tree biomass in each plot

- (7) The total tree biomass for each plot surveyed as provided by section 3.34 must be determined using the following formula:

$B_{sp,i,r} = AB_{sp,i,r} + BB_{sp,i,r}$	Equation 9
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Where:

- $B_{sp,i}$ = total biomass stock in sample plot (sp) in carbon estimation area (i) for reporting period (r) (tonnes of biomass).
- $AB_{sp,i,r}$ = total above-ground biomass stock of all trees in sample plot (sp) of carbon estimation area (i) for reporting period (r) (tonnes of biomass).
- $BB_{sp,i,r}$ = total below-ground tree biomass of trees in plot (sp) in carbon estimation area (i) for reporting period (r) (tonnes of dry matter).
- sp = denotes the spth sample plot in each carbon estimation area.
- i = the ith carbon estimation area.
- r = the rth reporting period.

3.36 Step 8—Edge corrections for plots crossing carbon estimation area boundaries

- (1) If a plot crosses the boundary of a carbon estimation area, the resulting edge effects must be corrected in accordance with this section.
- (2) If more than 20% of the plot falls outside the carbon estimation area that is to be surveyed, the plot must be omitted from the biomass survey.
- (3) If less than 20% of the plot falls outside the carbon estimation area that is to be surveyed, the mirage method must be used.
- (4) The effective orthogonal area of plots established using the mirage method must be consistent with the area of all other plots.
- (5) In this section:
mirage method means the process whereby the area of the plot falling outside of the carbon estimation area is established within the carbon estimation area that is being surveyed.

3.37 Step 9—Validation of sample size

- (1) An ex-post analysis of the data obtained in the biomass survey must be performed in order to verify that the survey performed in accordance with this Subdivision has achieved Targeted Precision.

Step 9.1—Standard error

- (2) The standard error must be calculated using the following formula:

$SE_{\text{survey},i,r} = \frac{S_{i,r}}{\sqrt{n_{i,r}}}$	Equation 10
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Where:

- $SE_{\text{survey},i}$ = standard error of the biomass survey in carbon estimation area (i) for reporting period (r).
- $S_{i,r}$ = standard deviation of the primary biomass survey data in carbon estimation area (i) for reporting period (r) (tonnes of dry matter).
- $n_{i,r}$ = number of samples in carbon estimation area (i) for reporting period (r).
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.

Step 9.2.—Determination of Targeted Precision

- (3) In order to determine whether the survey has achieved Targeted Precision, the following formula must be used:

$TP_{\text{survey},i,r} = \frac{SE_{\text{survey},i,r} \times t_{\text{val}}}{\bar{X}_{i,r}}$	Equation 11
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Where:

- $TP_{\text{survey},i}$ = Targeted Precision error limit of the primary biomass survey for a carbon estimation area (i) for reporting period (r).
- $SE_{\text{survey},i}$ = standard error of the biomass survey in carbon estimation area (i) for reporting period (r).
- t_{val} = two-sided students t-value, at the degree of freedom equal to (n-1) where (n) is the number of plots established in the biomass survey in each carbon estimation area, for a 90% confidence level.
- \bar{X} = sample mean from biomass survey data in carbon estimation area (i) for the reporting period (r) (tonnes of biomass).
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.

- (4) The 90% confidence level must be used when determining the t-value.
- (5) The final value of $TP_{\text{survey},i}$ must be less than or equal to 10%.
- (6) If $TP_{\text{survey},i}$ is greater than 10%, additional plots must be surveyed consistently with the requirements of this Subdivision until the Targeted Precision is less than or equal to 10%.

Subdivision 3.4.4 Calculation of baseline emissions

3.38 Calculating baseline emissions

The steps outlined in this Subdivision must be followed for the purposes of calculating the baseline emissions in the project area.

3.39 Baseline relevant carbon pools

For the purposes of this Subdivision, relevant carbon pools are limited to:

- (a) above-ground tree biomass;
- (b) below-ground tree biomass; and
- (c) the burning of biomass for the purposes of clearing.

3.40 Step 1—Surveying requirements

A biomass survey must be conducted in accordance with Subdivision 3.5.3.

3.41 Step 2—Calculating carbon stocks in carbon estimation area

Step 2.1—Determination of mean carbon stocks in each carbon estimation area

- (1) Following a biomass survey, the mean carbon stock in each carbon estimation area must be calculated using the following formula:

$C_{i,r} = \frac{\left(\sum_{sp=1}^p \frac{B_{sp,i,r}}{A_{sp,i}} \right)}{n_{i,r}} \times CF \times \frac{44}{12} \times (1 - NPT_i)$	Equation 12
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Where:

- $C_{i,r}$ = mean carbon stock in all pools in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent per hectare).
- $B_{sp,i,r}$ = total biomass stock of trees in sample plot (sp) of carbon estimation area (i) for reporting period (r) (tonnes of dry matter) as calculated in section 3.35.
- $A_{sp,i}$ = area of sample plot (sp) in carbon estimation area (i) (hectares).
- CF = 0.5, being the fraction of carbon in biomass.
- 44/12 = ratio of molecular weight of carbon dioxide to carbon.
- NPT_i = buffer representing the proportion of non-project tree biomass within area of carbon estimation area (i) as calculated using Equation 13).
- sp = the spth sample plot in each carbon estimation area.
- i = the ith carbon estimation area.

- r = the rth reporting period.
- n_{i,r} = number of sample plots measured in carbon estimation area (i) for reporting period (r).

Note Equation 12 is also used to calculate the mean carbon stocks in carbon estimation areas for each reporting period in which a biomass survey is undertaken.

Step 2.2—Non-project tree buffer

- (2) If the deforestation plan provides that certain trees in the project area must not be cleared, the following formula must be used to compute the constant, non-project tree buffer for each carbon estimation area using data collected in the first reporting period:

$NPT_i = \frac{\sum_{sp=1}^{SP} B_{NPT,sp,i,r}}{\sum_{sp=1}^{SP} B_{sp,i,r}}$	Equation 13
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Where:

- NPT_i = buffer representing the proportion of non-project tree biomass within area of carbon estimation area (i) in the first reporting period (r=1) estimated from in-field measurements as provided by Subdivision 3.4.3 and expressed as a decimal.
- B_{sp,i,r} = total biomass stock of trees in sample plot (sp) of carbon estimation area (i) for the first reporting period (r = 1) (tonnes of biomass).
- B_{NPT,sp,i,r} = total biomass stock of non-project trees in sample plot (sp) of carbon estimation area (i) for the first reporting period (r = 1) (tonnes of biomass) calculated by completing Equation 14.
- sp = the spth sample plot in each carbon estimation area.
- i = the ith carbon estimation area.
- r = the rth reporting period.

- (3) For the purposes of this Determination the non-project tree buffer is the percentage of biomass within a carbon estimation area not cleared under the deforestation plan.
- (4) If a carbon estimation area is re-stratified following disturbance, the non-project tree buffer of the carbon estimation area after re-stratification is equal to the non-project tree buffer of the carbon estimation area before re-stratification.

Step 2.3—Total biomass of non-project trees within each plot

- (5) The total biomass of non-project trees in each plot must be calculated using the following formula:

$B_{NPT,sp,i,r} = \sum_{j=1}^N (B_{NPT,j,sp,i,r} + (B_{NPT,j,sp,i,r} \times RSR))$	Equation 14
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Where:

- $B_{NPT,sp,i,r}$ = total biomass of non-project trees in sample plot (sp), in carbon estimation area (i) in the first reporting period (r=1)(tonnes of biomass).
- $B_{NPT,j,sp,i,r}$ = above-ground biomass of trees that may not be cleared under deforestation plan (j) in sample plot (sp) in carbon estimation area (i) in the first reporting period (r=1) (tonnes of biomass per tree).
- RSR = root:shoot ratio determined in accordance with section 3.28 (tonnes of root biomass per tonne of shoot biomass).
- j = the jth tree in sample plot (sp) in carbon estimation area (i) at time (t).
- sp = denotes the spth sample plot in each carbon estimation area.
- i = the ith carbon estimation area.
- r = the rth reporting period.

3.42 Step 3—Calculating carbon stocks in carbon estimation area following clearing

- (1) The long-term average carbon stocks in each carbon estimation area if clearing had been carried out in accordance with the deforestation plan must be calculated in accordance with this section.
- (2) The long-term average mean carbon stocks in all pools in each carbon estimation if clearing had been carried out in accordance with the deforestation plan must be calculated using the following formula:

$C_{BSL,i,post} = \frac{\left(\sum_{sp=1}^P \frac{B_{lt,sp,i}}{A_{sp,i}} \right)}{n_i} \times CF \times \frac{44}{12}$	Equation 15
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Where:

- $C_{BSL,i,post}$ = long term average mean carbon stock in all pools in carbon estimation area (i) following clearing in accordance with the deforestation plan (tonnes of carbon dioxide equivalent per hectare).
- $B_{lt,sp,i}$ = long term average biomass stock of trees in sample plot (sp) of carbon estimation area (i) following clearing in accordance with the deforestation plan (tonnes of biomass) calculated in accordance with Equation 20.
- $A_{sp,i}$ = area of sample plot (sp) in carbon estimation area (i) (hectares).
- sp = the spth sample plot in each carbon estimation area.
- i = the ith carbon estimation area.

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- CF = fraction of carbon in biomass, set at 0.5 as consistent with the National Inventory System.
 - 44/12 = ratio of molecular weight of carbon dioxide to carbon (tonnes of carbon dioxide equivalent per tonnes of carbon).
 - n_i = number of sample plots measured in carbon estimation area (i).

Step 3.1—100 year average of biomass within sample plots following clearing

- (3) Steps 3.1.1 to 3.1.5 must be completed in order to determine the 100 year average biomass stock in the sample plots following clearing in accordance with the deforestation plan.

Step 3.1.1—Model biomass in debris pool

- (4) The biomass stock in the debris pool within each plot must be calculated using the following formula:

$B_{\text{Debris},sp,i} = B_{sp,i,r}$	Equation 16
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Where:

- $B_{\text{Debris},sp,i}$ = biomass in the debris pool following clearing in accordance with the deforestation plan in sample plot (sp) in carbon estimation area (i) (tonnes of biomass).
- $B_{sp,i,r}$ = biomass stock in all pools within plot (sp) prior to clearing in accordance with the deforestation plan in carbon estimation area (i) for the first reporting period ($r=1$) (tonnes of dry matter) as calculated in accordance with Equation 9.
- sp = the sp^{th} sample plot in each carbon estimation area.
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.

Step 3.1.2—Partition of biomass into Major Vegetation Group tree components

- (5) The biomass of each plot must be partitioned into its Major Vegetation Group tree components in order to determine the impact of treatment and decay on each component of the tree.
- (6) Biomass partitioning must be performed in accordance with the biomass fractions in Schedule 1.
- (7) The biomass of stems, branches, bark, leaves, coarse roots and fine roots in each sample plot in each carbon estimation area must be determined using the applicable biomass fractions in Schedule 1 and the following formula:

$$B_{tc,sp,i} = B_{Debris,sp,i} \times B_{fraction\ tc\ in\ MVG}$$

Equation 17

Where:

$B_{tc,sp,i}$ = biomass of tree component (tc) in sample plot (sp) in carbon estimation area (i) as determined for each tree component (tc) (tonnes of biomass).

tc = tree component ($B_{stem,i}$, $B_{branch,i}$, $B_{bark,i}$, $B_{leaves,i}$, $B_{coarse_roots,i}$, $B_{fine_roots,i}$).

i = the i^{th} carbon estimation area.

sp = the sp^{th} sample plot in each carbon estimation area.

$B_{debris,sp,i}$ = biomass in the debris pool following clearing in accordance with the deforestation plan in sample plot (sp), in carbon estimation area (i) (tonnes of biomass).

(8) In relation to $B_{fraction\ tc\ in\ MVG}$, the biomass fraction for each tree component is:

$B_{stem,sp,i}$ = biomass fraction of stems for Major Vegetation Group of plot;

$B_{branch,sp,i}$ = biomass fraction of branches for Major Vegetation Group of plot;

$B_{bark,sp,i}$ = biomass fraction of bark for Major Vegetation Group of plot;

$B_{leaves,sp,i}$ = biomass fraction of leaves for Major Vegetation Group of plot;

$B_{coarse_roots,sp,i}$ = biomass fraction of coarse roots for Major Vegetation Group of plot; and

$B_{fine_roots,sp,i}$ = biomass fraction of fine roots for Major Vegetation Group of plot;

as specified in Table 1.1 and Table 1.2 in Schedule 1.

Step 3.1.3—Treatment of the debris pool

(9) The biomass residue following a burning event must be calculated using the following formula:

$$B_{residue,tc,sp,i} = B_{tc,sp,i} \times (BB - (BB \times BE_{tc}) + UB)$$

Equation 18

Where:

$B_{residue,tc,sp,i}$ = biomass residue post burning event, of tree component (tc) in sample plot (sp) in carbon estimation area (i) (tonnes of dry matter).

$B_{tc,sp,i}$ = biomass of tree component (tc) in sample plot (sp) in carbon estimation area (i) as determined for each tree component in Step 3.1.2 in this section (tonnes of biomass).

BB = 0.25, being the proportion of biomass burnt as a result of fire.

- BE_{tc} = burn efficiency for tree component (tc) (see Schedule 1 for tree component burn efficiencies).
- UB = 0.75, being the proportion of biomass unburnt as a result of fire.
- tc = tree component (B_{stem,i}, B_{branch,i}, B_{bark,i}, B_{leaves,i}, B_{coarse_roots,i}, B_{fine_roots,i}).
- i = the ith carbon estimation area.
- sp = the spth sample plot in each carbon estimation area.

Step 3.1.4—Average long term carbon stock of tree components

- (10) The long-term average carbon stock of the biomass residue must be calculated using the following formula:

$B_{\text{average ,tc,sp,i}} = \frac{(\sum_{td}^{100} (B_{\text{residue ,tc,sp,i}} \times (1 - DR)^{td})) + B_{\text{residue ,tc,sp,i}}}{100}$	Equation 19
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Where:

- B_{average,sp,tc,i} = 100 year average biomass of tree component (tc) in sample plot (sp) in carbon estimation area (i) (tonnes of biomass).
- B_{residue,tc,sp,i} = biomass residue post burning event, of tree component (tc), in sample plot (sp), in carbon estimation area (i) (tonnes of dry matter).
- DR = decay rate for tree component (tc) in sample plot (sp v), as determined in Schedule 1.
- td = the tdth year for each year of decay in the 100 year modelling period where td = 1 to 100.
- tc = tree component (B_{stem,i}, B_{branch,i}, B_{bark,i}, B_{leaves,i}, B_{coarse_roots,i}, B_{fine_roots,i}).
- i = the ith carbon estimation area.
- sp = the spth sample plot in each carbon estimation area.

Step 3.1.5—Sum of average long term carbon stock of each tree component

- (11) The average biomass in each sample plot in each carbon estimation area must be calculated using the following formula:

$B_{\text{lt,sp,i}} = \sum_{tc} B_{\text{average ,tc,sp,i}}$	Equation 20
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Where:

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- $B_{lt,sp,i}$ = long term average biomass for sample plot (sp) in carbon estimation area (i) (tonnes of biomass).
- $B_{average,tc,sp,i}$ = 100 year average biomass of tree component (tc) for sample plot (sp) in carbon estimation area (i) (tonnes of biomass).
- tc = tree component ($B_{stem,i}$, $B_{branch,i}$, $B_{bark,i}$, $B_{leaves,i}$, $B_{coarse_roots,i}$, $B_{fine_roots,i}$).
- i = the i^{th} carbon estimation area.
- sp = the sp^{th} sample plot in each carbon estimation area.

3.43 Step 4—Calculating changes in baseline carbon stock in each carbon estimation area

The change in baseline carbon stocks during the crediting period as a result of the implementation of the deforestation plan must be calculated in the first reporting period using the parameters obtained in Step 2.1 in section 3.41 and Step 3 in subsection 3.42(2) and the following formula:

$\Delta C_{BSL,i} = C_{i,r} - C_{BSL,i,post}$	Equation 21
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Where:

- $\Delta C_{BSL,i}$ = mean carbon stock changes in all pools in the baseline within carbon estimation area (i) (tonnes of carbon dioxide equivalent per hectare).
- $C_{i,r}$ = mean carbon stock in all pools within carbon estimation area (i) in carbon estimation area (i) for the first reporting period ($r = 1$) (tonnes of carbon dioxide equivalent per hectare) calculated in Equation 12.
- $C_{BSL,i,post}$ = mean carbon stock in all pools in the baseline at end of crediting period in carbon estimation area (i) (tonnes of carbon dioxide equivalent per hectare) calculated in Equation 15.
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.

3.44 Step 5—Calculation of emissions in each carbon estimation area in the baseline

- (1) The methane and nitrous oxide emissions released as a result of the burning of biomass following clearing in accordance with the deforestation plan must be accounted for in accordance with this section.

Step 5.1—Pre-fire above-ground biomass stock

- (2) The above-ground biomass stock in each carbon estimation area that will be burned must be calculated using the following formula:

$B_i = C_{i,r} \times A_i \times \frac{12}{44} \times \frac{1}{CF}$	Equation 22
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Where:

- B_i = biomass within the debris pool from clearing in carbon estimation area (i) (tonnes of biomass).
- A_i = area of carbon estimation area (i) (hectares).
- $C_{i,r}$ = mean carbon stock in all pools in the baseline in carbon estimation area (i) for the first reporting period ($r = 1$) (tonnes of carbon dioxide equivalent per hectare) calculated in Equation 12.
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.
- $1/CF$ = inverse of the carbon fraction of biomass.
- $12/44$ = inverse ratio of molecular weight of carbon dioxide to carbon.

Step 5.2—Determination of methane and nitrous oxide emissions from biomass burns

- (3) The methane and nitrous oxide emissions associated with the burning event must be calculated using the following formulas:

Step 5.2.1—Determination of methane emissions from fire events

$E_{CH_4,i} = B_i \times CF \times EF_{i,g} \times GWP_g \times MM$	Equation 23
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Step 5.2.2—Determination of nitrous oxide emissions from fire events

$E_{N_2O,i} = B_i \times CF \times NC \times EF_{i,g} \times GWP_g \times MM$	Equation 24
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Where:

- $E_{CH_4,i}$ = methane emissions due to fire events in carbon estimation area (i) (tonnes of carbon dioxide equivalent).
- $E_{N_2O,i}$ = nitrous oxide emissions due to fire events in carbon estimation area (i) (tonnes of carbon dioxide equivalent).
- B_i = biomass within the debris pool from forest conversion activities in carbon estimation area (i) (tonnes of biomass).
- CF = 0.5, being the carbon mass fraction of vegetation.
- EF_g = emission factor for gas species (g); t element in species/t element in fuel burnt (data must be accessed in table 7.21 of the National Inventory Report, 2010: Volume 2).
- GWP_g = Global warming potential for gas (g) (tonnes of carbon dioxide per tonne of gas (g)) as specified in the NGER Regulations.

- MM = factor to convert elemental mass of gas species (g) to molecular mass (data must be accessed from table 7.22 of the National Inventory Report, 2010: Volume 2).
- NC = 0.011, being the nitrogen to carbon ratio of the biomass.
- g = greenhouse gas methane (CH₄) or nitrous oxide (N₂O).
- i = the ith carbon estimation area.

Step 5.3—Determination of greenhouse gas emissions from biomass burning

- (4) The greenhouse gas emissions associated with the biomass burning event must be calculated using the following formula:

$E_{\text{BiomassBurn},i} = E_{\text{CH}_4,i} + E_{\text{N}_2\text{O},i}$	Equation 25
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Where:

- $E_{\text{BiomassBurn},i}$ = greenhouse gas emissions due to biomass burning in carbon estimation area (i) (tonnes of carbon dioxide equivalent).
- $E_{\text{CH}_4,i}$ = methane emissions due to biomass burning, as determined in accordance with Equation 23, in carbon estimation area (i) (tonnes carbon dioxide equivalent).
- $E_{\text{N}_2\text{O},i}$ = nitrous oxide emissions due to biomass burning, as determined in accordance with Equation 24, in carbon estimation area (i) (tonnes of carbon dioxide equivalent).
- i = the ith carbon estimation area.

- (5) The total greenhouse gas emissions from burning in relation to each carbon estimation area must be redefined using the following formula:

$E_{\text{BSL},i} = E_{\text{BiomassBurn},i}$	Equation 26
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Where:

- $E_{\text{BSL},i}$ = baseline greenhouse gas emissions as a result of clearing in accordance with the deforestation plan within carbon estimation area (i) (tonnes of carbon dioxide equivalent).
- $E_{\text{BiomassBurn},i}$ = non-carbon dioxide emissions due to biomass burning in carbon estimation area (i), calculated in accordance with Equation 25 (tonnes of carbon dioxide equivalent per year).
- i = the ith carbon estimation area.

3.45 Step 6—Calculating net baseline greenhouse gas emissions

The net baseline greenhouse gas emissions and removals must be calculated using the parameters derived in Equations 21 and 26 and the following formula:

$$GHG_{NET\ BSL} = \sum_{i=1}^{CEA} \left((A_i \times \Delta C_{BSL,i}) + E_{BSL,i} \right)$$

Equation 27

Where:

$GHG_{NET\ BSL}$ = net greenhouse gas emissions in the baseline from clearing in accordance with the deforestation plan (tonnes of carbon dioxide equivalent).

A_i = area of carbon estimation area (i) (hectares).

$\Delta C_{BSL,i}$ = mean carbon stock changes in all pools in the baseline carbon estimation area (i) (tonnes of carbon dioxide equivalent) during the crediting period.

$E_{BSL,i}$ = greenhouse gas emissions as a result of implementing the deforestation plan in the project area, in carbon estimation area (i).

i = the i^{th} carbon estimation area.

Subdivision 3.4.5 Calculation of project emissions and removals

3.46 Calculating project emissions and removals

The steps outlined in this Subdivision must be followed for the purposes of calculating the project emissions in the project area.

3.47 Project relevant carbon pools

For the purposes of this Subdivision, relevant carbon pools are limited to:

- (a) above-ground tree biomass;
- (b) below-ground tree biomass;
- (c) the combustion of fossil fuels in vehicles, machinery and equipment; and
- (d) the burning of biomass in controlled burns.

3.48 Step 1—Project forest carbon stock changes in carbon estimation area resulting from disturbances

Step 1.1—Accounting for degradation and natural disturbances in the project

- (1) When an area of degradation or natural disturbance has been re-stratified into a new carbon estimation area as required by section 3.7:
 - (a) the biomass stocks in the carbon estimation area mentioned in subsection (1) must be calculated by resurveying the new carbon estimation area in accordance with Subdivision 3.4.3; or

- (b) the carbon stocks in the new carbon estimation area must be set to zero.
- (2) For the purposes of paragraph (1)(a):
- (a) all dead biomass in the new carbon estimation area is taken to have a biomass of zero; and
- (b) the survey must include only standing living trees in the new carbon estimation area.
- (3) When the requirements of subsection (1) have been met, the following formula must be completed:

$\Delta C_{\text{Pools,DEG},i,r} = C_{\text{INV},i,\text{pre}} - C_{i,r}$	Equation 28
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Where:

$\Delta C_{\text{pools,DEG},i,r}$ = mean carbon stock changes in all pools as a result of degradation or natural disturbance in carbon estimation area (i) (tonnes of carbon dioxide equivalent per hectare).

$C_{\text{INV},i,\text{pre}}$ = mean carbon stock in all pools ($C_{i,r}$) in carbon estimation area (i) as reported in the preceding offsets report. For the first offsets report following disturbance, carbon estimation area (i) means the original (not re-stratified) carbon estimation area.

$C_{i,r}$ = mean carbon stock in all pools measured in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent per hectare).

i = the ith carbon estimation area.

r = reporting period (r).

- (4) When Step 1.1 in this section has been completed, Step 1.2 must be completed.

Step 1.2—Net carbon stock changes resulting from degradation or natural disturbance in carbon estimation area

- (5) The net project carbon stock changes in all pools as a result of degradation or natural disturbance must be calculated using the following formula:

$\Delta C_{\text{P,DEG},i,r} = A_{\text{DEG},i} \times \Delta C_{\text{pools,DEG},i,r}$	Equation 29
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Where:

$\Delta C_{\text{P,DEG},i,r}$ = net project carbon stock changes in all pools as a result of degradation or natural disturbance, in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).

$A_{\text{DEG},i}$ = area of delineated degradation or natural disturbance event in the carbon estimation area (i) (hectares).

$\Delta C_{\text{pools,DEG},i,r}$ = mean carbon stock changes in all pools from the degradation or natural disturbance event, in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent per hectare).

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- i = the ith carbon estimation area.
 - r = the rth reporting period.

3.49 Step 2—Optional calculation of carbon stock enhancements

- (1) Project carbon stock enhancements may be accounted for.

Step 2.1—Biomass survey to determine current biomass carbon stocks in carbon estimation areas where carbon stock enhancements are occurring

- (2) Each carbon estimation area for which carbon stock enhancements are calculated must be surveyed.
- (3) The survey in subsection (2) must:
 - (a) meet the requirements of Subdivision 3.4.3; and
 - (b) achieve the Targeted Precision.
- (4) The net carbon stock changes as a result of forest carbon stock enhancement must be calculated using the following formula:

$\Delta C_{P,ENH,i,r} = (C_{i,r} - C_{INV,i,pre}) \times A_{ENH,i}$	Equation 30
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Where:

- $\Delta C_{P,ENH,i,r}$ = net carbon stock changes as a result of forest carbon stock enhancement in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- $C_{i,r}$ = mean carbon stock in all pools measured in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent per hectare).
- $C_{INV,i,pre}$ = mean carbon stock in all pools ($C_{i,r}$) as reported at the time of the preceding offsets report in carbon estimation area (i).
- $A_{ENH,i}$ = area of carbon estimation area (i) in which carbon stock enhancements are being undertaken and monitored (hectares).
- i = the ith carbon estimation area.
- r = the rth reporting period.

3.50 Step 3—Calculating project emissions

- (1) The emissions resulting from fire events and the combustion of fossil fuels must be calculated in accordance with this section.

Step 3.1—Determination of emissions from degradation or natural disturbance events involving a fire event

Step 3.1.1—Determination of mass of biomass burnt from fires

- (2) The biomass burnt from fires in each carbon estimation area must be determined using the following formula:

$BB_{\text{fire},i,r} = A_{\text{burn},i,r} \times FL_i \times BE_{\text{bt},i}$	Equation 31
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Where:

- $BB_{\text{fire},i,r}$ = biomass burned from fires in carbon estimation area (i) for reporting period (r) (tonnes of biomass).
- $A_{\text{burn},i,r}$ = area burned in carbon estimation area (i) during reporting period (r) (hectares).
- FL_i = fuel load of carbon estimation area (i) (tonnes of biomass per hectare) (specified in table 7.17 of the National Inventory Report, 2010: Volume 2).
- BE_i = burn efficiency for either controlled burning or wildfires in carbon estimation area (i) (specified in table 7.19 of the National Inventory Report, 2010: Volume 2).
- bt = burn type, either wildfire or controlled burn.
- i = the ith carbon estimation area.
- r = the rth reporting period.

Step 3.1.2 – Determination of methane and nitrous oxide emissions from wildfires and controlled burns

- (3) The methane and nitrous oxide emissions associated with each fire event must be determined using Equations 32, 33 and 34.

Step 3.1.2.1—Determination of methane emissions from fire events

$E_{\text{CH}_4,i,r} = BB_{\text{fire,bt},i,r} \times CF \times EF_{g,i} \times GWP_g \times MM$	Equation 32
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Step 3.1.2.2—Determination of nitrous oxide emissions from fire events

$E_{\text{N}_2\text{O},i,r} = BB_{\text{fire,bt},i,r} \times CF \times NC \times EF_{g,i} \times GWP_g \times MM$	Equation 33
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Step 3.1.3—Determination of emissions from fire events

$E_{\text{fire},i,r} = \sum_{\text{bt}} E_{\text{CH}_4,i,r} + E_{\text{N}_2\text{O},i,r}$	Equation 34
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Where:

- $E_{\text{fire},i,r}$ = greenhouse gas emissions due to fire events in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- $E_{\text{CH}_4,i,r}$ = methane emissions due to fire events in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- $E_{\text{N}_2\text{O},i,r}$ = nitrous oxide emissions due to fire events in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- CF = 0.5, being the carbon mass fraction in vegetation.
- $EF_{g,i}$ = emission factor for gas species g; t element in species/t element in fuel burnt (data must be accessed from table 7.21 of the National Inventory Report, 2010: Volume 2).
- GWP_g = global warming potential for gas (g) (tonnes of carbon dioxide per tonne of gas (g)) as specified in the NGER Regulations.
- MM = factor to convert elemental mass of gas species g to molecular mass (data must be accessed from table 7.22 of the National Inventory Report, 2010: Volume 2).
- NC = 0.011, being the nitrogen to carbon ratio in biomass.
- g = greenhouse gas methane (CH₄) or nitrous oxide (N₂O).
- i = the ith carbon estimation area.
- r = the rth reporting period.
- bt = burn type, either wildfire or controlled burn.

Step 3.3—Determine emissions from fossil fuel combustion

- (4) The emissions from fuel use for each carbon estimation area during each reporting period must be calculated using the following formula:

$E_{\text{FC},i,r} = \sum_g \sum_a E_{g,a,i,r}$	Equation 35
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Where:

- $E_{\text{FC},i,r}$ = net emissions of fuel consumption in carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- $E_{g,a,i,r}$ = emissions of greenhouse gas (g) from consumption of fuel type (a) for carbon estimation area (i) during reporting period (r) (tonnes of carbon dioxide equivalent) calculated in accordance with Step 3.3.1 in this section.
- a = fuel type (a) (e.g. diesel, Gasoline, etc.) as specified in Schedule 1, Part 4 of the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

- g = greenhouse gas type: carbon dioxide (CO₂), methane(CH₄) or nitrous oxide (N₂O).
- i = the ith carbon estimation area.
- r = the rth reporting period .

Step 3.3.1—Calculating emissions for fossil fuel types

- (5) Emissions of carbon dioxide, methane and nitrous oxide from the consumption of fossil fuels for reporting period (r) must be calculated using the following formula:

$E_{g,a,i,r} = \frac{Q_{a,i,r} \times ECF_a \times EF_{g,a}}{1000}$	Equation 36
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Where:

- $E_{g,a,i,r}$ = emissions of greenhouse gas (g) from consumption of fuel type (a) for carbon estimation area (i) during reporting period (r) (tonnes of carbon dioxide equivalent).
- $Q_{a,i,r}$ = the quantity of fossil fuel type (a) consumed in carbon estimation area (i) during reporting period (r) (kilolitres).
- ECF_a = energy content factor of fossil fuel type (a) (gigajoules per kilolitre) determined in Schedule 1, Part 4 of the National Greenhouse and Energy Reporting (Measurement) Determination 2008.
- $EF_{g,a}$ = emission factor for each gas type (g) for fossil fuel type (a) (kilograms of carbon dioxide equivalent per gigajoule) Determined in Schedule 1, Part 4 of the National Greenhouse and Energy Reporting (Measurement) Determination 2008.
- g = greenhouse gas type: carbon dioxide (CO₂), methane(CH₄) or nitrous oxide (N₂O).
- a = fuel type (a) (e.g. diesel, Gasoline, etc.) as specified in Schedule 1, Part 4 of the National Greenhouse and Energy Reporting (Measurement) Determination 2008.
- i = the ith carbon estimation area.
- r = the rth reporting period.

Step 3.4—Determination of project greenhouse gas emissions for a reporting period

- (6) The project greenhouse gas emissions during a reporting period must be calculated using the following formula:

$E_{P,i,r} = E_{FC,i,r} + E_{fire,i,r}$	Equation 37
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Where:

- $E_{P,i,r}$ = project greenhouse gas emissions, for carbon estimation area (i) for reporting period (r) (tonnes of carbon dioxide equivalent).
- $E_{FC,i,r}$ = emissions from fossil fuel combustion in carbon estimation area (i) for reporting period (r) calculated in accordance with Equation 35 (tonnes of carbon dioxide equivalent).
- $E_{fire,i,r}$ = nitrous dioxide and methane emissions due to biomass burnt due to fires in carbon estimation area (i) for reporting period (r), calculated in accordance with Equation 34 (tonnes of carbon dioxide equivalent).
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.

3.51 Step 4—Calculating total net greenhouse gas project emissions for reporting period and crediting period

The total net greenhouse gas project emissions for each carbon estimation area in a reporting period must be calculated using the following formula:

$GHG_{NET P} = \sum_{A_r=1}^{A_r} \sum_{i=1}^{CEA} \Delta C_{P,DEG,i,r} + E_{P,i,r} - \Delta C_{P,ENH,i,r}$	Equation 38
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Where:

- $GHG_{NET P}$ = net project emissions (tonnes of carbon dioxide equivalent) in the project area for all reporting periods (r).
- $\Delta C_{P,DEG,i,r}$ = net project carbon stock change as a result of any degradation events in the project area in carbon estimation area (i) during reporting period (r) (calculated in accordance with Equation 29) (tonnes of carbon dioxide equivalent).
- $E_{P,i,r}$ = emissions within the project area in carbon estimation area (i) during reporting period (r) (calculated in accordance with Equation 37) (tonnes of carbon dioxide equivalent).
- $\Delta C_{P,ENH,i,r}$ = net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in carbon estimation area (i) during reporting period (r) (calculated in accordance with Equation 30) (tonnes of carbon dioxide equivalent).
- i = the i^{th} carbon estimation area.
- r = the r^{th} reporting period.
- A_r = each reporting period (r) including the current reporting period.

Subdivision 3.4.6 Calculating net greenhouse gas abatement

3.52 Net greenhouse gas abatement

- (1) The net greenhouse gas abatement for the project at the time of the submission of an offsets report must be calculated in accordance with this Subdivision.
- (2) The net greenhouse gas abatement in the crediting period must be calculated using the parameters derived in Subdivisions 3.5.4 and 3.5.5 and in accordance with the following formula:

$\text{GHG}_{\text{report}} = \text{GHG}_{\text{NET BSL}} - \text{GHG}_{\text{NET P}} - \text{GHG}_{\text{NET LK}}$	Equation 39
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Where:

$\text{GHG}_{\text{report}}$ = net greenhouse gas abatement at the end of current reporting period (tonnes of carbon dioxide equivalent).

$\text{GHG}_{\text{NET BSL}}$ = net greenhouse gas emissions in the baseline from planned deforestation (tonnes of carbon dioxide equivalent) determined in accordance with Subdivision 3.5.4.

$\text{GHG}_{\text{NET P}}$ = net project carbon dioxide equivalent emissions (tonnes of carbon dioxide equivalent) as determined in accordance with Subdivision 3.5.5.

$\text{GHG}_{\text{NET LK}}$ = 0, being the quantity of abatement lost due to leakage by the project.

- (3) The project proponent must report GHG_{NET} as the Net Sequestration Number for the project to the Regulator in each offsets report.

$\text{GHG}_{\text{NET}} = \left(\frac{\text{GHG}_{\text{report}} - \frac{\text{Credits}}{0.95}}{\text{Crediting Period} - t_{\text{start}} + R_t} \right) \times \text{Crediting Period}$	Equation 40
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Where:

GHG_{NET} = net greenhouse gas abatement for the crediting period (tonnes of carbon dioxide equivalent).

$\text{GHG}_{\text{report}}$ = net greenhouse gas abatement at the end of current reporting period (tonnes of carbon dioxide equivalent).

Credits = the number of Australian carbon credit units already issued for the project.

Crediting Period = the crediting period for the project (years).

t_{start} = number of years since project commencement.

R_t = number of years in the current reporting period (years).

0.95 = constant which accounts for a risk of reversal buffer of 5%.

Part 4 Monitoring, record-keeping and reporting requirements

Note See subsection 106(3) of the Act.

Division 4.1 General

4.1 Application

For subsection 106(3) of the Act, the project proponent of an eligible offsets project to which this Determination applies must comply with the monitoring, record-keeping and reporting requirements of this Part.

Division 4.2 Monitoring requirements

4.2 Monitoring for disturbance

- (1) The project area must be monitored for disturbances in the course of each reporting period.
- (2) For the purposes of subsection (1), remotely-sensed imagery of the project area must:
 - (a) be acquired no longer than one year before the submission of the next offsets report; and
 - (b) comply with the requirements in section 3.2.
- (3) A land cover assessment of the remotely-sensed imagery must be completed in accordance with section 3.3.

Division 4.3 Record-keeping requirements

4.3 Information relating to project area and land cover assessment

- (1) Records must be kept in relation to:
 - (a) the boundary of the project area; and
 - (b) each land cover assessment undertaken in accordance with section 3.3.
- (2) For the purposes of subsection (1), the records must include:
 - (a) the data source used to generate the project area;
 - (b) the geographic coordinates of each carbon estimation area, exclusion area and clearing buffer within the project area;
 - (c) the meta-data relating to the areas in paragraph (c) as provided by the CFI Mapping Guidelines;
 - (d) the total project area (hectares);

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- (e) the area of each carbon estimation area (hectares); and
 - (f) the method used to stratify the project area.

4.4 Information relating to project eligibility

Records must be kept in relation to each of the evidentiary requirements set out in section 2.4.

4.5 Information relating to remotely-sensed imagery

Records must be kept in relation to each of the requirements for remotely-sensed imagery set out in section 3.2.

4.6 Information relating to biomass survey report

- (1) Records must be kept in relation to:
 - (a) the plot design selected in accordance with section 3.29;
 - (b) the number of plots estimated to achieve Targeted Precision in accordance with section 3.32;
 - (c) the name of the pseudo-random number generator used to allocate plot points in accordance with section 3.30;
 - (d) the seed number used in the pseudo-random number generator mentioned in paragraph (c);
 - (e) the method for establishing plots in accordance with Subdivision 3.4.3;
 - (f) the survey protocol for the biomass survey in accordance with Subdivision 3.4.3;
 - (g) plot data including:
 - (i) the species of each tree found in the plot;
 - (ii) measurement data for each tree measured in all plots surveyed;
 - (iii) the project name (NAME);
 - (iv) the CEA number to which plots are allocated (CEA_NUM);
 - (v) the unique identifier for each plot (PLOT_NUM);
 - (vi) the waypoint X coordinate in decimal degrees (X_VALUE);
 - (vii) the waypoint Y coordinate in decimal degrees (Y_VALUE); and
 - (viii) the date of allocation points to the CEA (DATE_REG);
 - (h) the process or method for the calibration of all survey equipment requiring calibration; and
 - (i) GPS unit specifications including the accuracy of each device used in the field for the purposes of undertaking the biomass survey in accordance with Subdivision 3.4.3.
- (2) For the purposes of paragraph (1)(b) the records must include:

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- (a) a spread-sheet compiling information collected in accordance with sections 3.31 and 3.32; and
 - (b) the validation of the sample size as provided by section 3.37.
- (3) For the purposes of paragraphs (1)(e) and (1)(f) the records must include:
- (a) photographic examples of field plots; and
 - (b) a field manual or other documentation outlining the steps field workers must follow:
 - (i) to navigate to plots;
 - (ii) to establish plot data;
 - (iii) to establish plot boundaries; and
 - (iv) to collect plot data.
- (4) For the purposes of paragraph (1)(h) the records may include documentation recording:
- (a) the calibration process; and
 - (b) calibration dates signed by the field leader.

4.7 Information relating to allometric equations

- (1) Records must be kept in relation to each allometric equation used to estimate above-ground biomass.
- (2) For the purposes of subsection (1) the records must include:
 - (a) a unique identifier for the allometric equation;
 - (b) the original reference for each third-party allometric equation;
 - (c) the mathematical form for the allometric equation including parameter values;
 - (d) the allometric domain for the allometric equation defined in accordance with section 3.16;
 - (e) details on plot size and shape;
 - (f) the number of plots as determined in accordance with section 3.18;
 - (g) the name of the pseudo-random number generator used to allocate plot points in accordance with section 3.30;
 - (h) the seed number used in the pseudo-random number generator in section 3.33;
 - (i) the size-classes as defined in section 3.21;
 - (j) information on plots assigned for destructive sampling including:
 - (i) a unique identifier for each plot;
 - (ii) the latitude and longitude of the plot waypoint in decimal degrees;
 - (iii) the species found in the plot;

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- (iv) a unique identifier for each biomass sample tree;
 - (v) the size class represented by each biomass sample tree as determined in accordance with section 3.21; and
 - (vi) measurements for each biomass sample tree as determined in accordance with section 3.35;
- (k) the method of random selection of trees from survey plots for destructive sampling used in accordance with section 3.35;
 - (l) the number of biomass sample trees selected for destructive sampling;
 - (m) the unique identifier of each biomass sample tree selected for destructive sampling;
 - (n) average wet and dry weights and dry to wet weight ratios for biomass components and sample trees;
 - (o) the coefficient of variation of the average whole-tree dry to wet weight ratio;
 - (p) information about the sample trees assessed in order to develop or validate the allometric equation;
 - (q) information about regression plots showing the spread of data points and regression fit;
 - (r) information about plots showing the spread and distribution of the weighted residuals;
 - (s) the mean of the weighted residuals calculated in accordance with section 3.25; and
 - (t) the outcome of checks against conditions specified in subsection 3.25(13).

4.8 Information relating to emissions and abatement calculations

- (1) All data required for the calculations in Subdivisions 3.4.4, 3.4.5 and 3.4.6 must be recorded.
- (2) Records of fuel use for the project.
- (3) The data mentioned in subsection (1) must be kept for 10 years after it is submitted with an offsets report.

Division 4.4 Offsets report requirements

4.9 Requirements for the first offsets report

The first offsets report must include:

- (a) the deforestation plan mentioned in subsection 3.12(1);
- (b) evidence of the mix of species mentioned in subsection 2.5(2); and
- (c) the information specified in section 4.10.

4.10 Requirements for all offsets reports

- (1) Each offsets report for a project to which this Determination applies must state the:
 - (a) estimated carbon stocks for each carbon estimation area as calculated in accordance with Equation 12;
 - (b) Targeted Precision error limit of the primary biomass survey as calculated in accordance with Equation 11;
 - (c) net greenhouse gas emissions in the baseline from clearing in accordance with the deforestation plan as calculated in accordance with Equation 27;
 - (d) net project carbon dioxide equivalent emissions within the project area in each carbon estimation area during the reporting period as calculated in accordance with Equation 38;
 - (e) net greenhouse gas abatement at the end of the reporting period as calculated in accordance with Equation 39;
 - (f) net greenhouse gas abatement for the crediting period as calculated in accordance with Equation 40; and
 - (g) length of the reporting period.
- (2) Each offsets report must include:
 - (a) a biomass survey report, including:
 - (i) a list of carbon estimation areas within the project area at the end of the reporting period;
 - (ii) dates of the most recent biomass surveys conducted in accordance with the Determination for each carbon estimation area;
 - (iii) the number of plots assessed within each carbon estimation area;
 - (iv) a map showing intended and realised plot locations for the most recent biomass survey for each carbon estimation area;
 - (v) a list of species found within each carbon estimation area;
 - (vi) the minimum, maximum and mean explanatory variables for each species measured within each carbon estimation area;
 - (vii) the estimated stocking rate of non-project trees for each carbon estimation area; and
 - (viii) a summary of equipment calibration procedures;
 - (b) an emissions report, including:
 - (i) an estimate of the quantity of fuel used within the project area during the reporting period;
 - (ii) an estimate of the greenhouse gas emissions from fossil fuel use calculated in accordance with Equation 36;
 - (iii) an estimate of the greenhouse gas emissions from disturbances calculated in accordance with Equation 34;
 - (c) an allometric report, including:

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- (i) the details of each allometric equation used to estimate above-ground biomass including the unique identifier of the allometric equation;
 - (ii) the full reference for any third-party allometric equation;
 - (iii) the mathematical form for the allometric equation including parameter values;
 - (iv) the outcomes of allometric domain confirmation in accordance with section 3.25;
 - (v) the reporting period within which the allometric equation was developed or validated;
 - (vi) for each allometric equation developed or validated within the reporting period:
 - (A) the number of trees destructively sampled;
 - (B) the species of each tree destructively sampled;
 - (C) the measured explanatory variables for each tree destructively sampled;
 - (D) which trees were measured to estimate wet weight, or both wet and dry weight;
 - (E) the average dry to wet weight ratios developed from sample trees;
 - (F) the coefficient of variation of the dry to wet weight ratios developed from sample trees;
 - (G) the plot location and plot identifier for each sample tree destructively sampled (plot location);
 - (H) the mean of the weighted residuals calculated in accordance with subsections 3.24(13) and 3.25(13); and
 - (I) for each allometric equation developed, the outcome of checks against conditions specified in subsections 3.24(5), 3.24(8) and 3.24(10); and
- (d) a monitoring report, including:
- (i) the remotely-sensed imagery of the project area used for monitoring, including information about:
 - (A) spatial resolution;
 - (B) date of imagery;
 - (C) source of imagery;
 - (ii) the outcome of the most recent land cover assessment;
 - (iii) any management actions undertaken in the project area in response to an identified disturbance; and

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- (iv) any management action undertaken in the project altering the composition of species within the project area.

Schedule 1 Partitioning of biomass

Table 1.1: Partitioning of biomass (stems, branches, bark)

National Vegetation Information System Major Vegetation Groups	Biomass fraction to stems (fraction)	Biomass fraction to branches (fraction)	Biomass fraction to bark (fraction)
Rainforest and Vine Thickets	0.78	0.06	0.06
Eucalypt Tall Open Forest	0.67	0.09	0.1
Eucalypt Open Forest	0.45	0.12	0.1
Eucalypt Low Open Forest	0.45	0.12	0.1
Eucalypt Woodlands	0.44	0.15	0.1
Acacia Forest and Woodland	0.42	0.15	0.1
Callitris Forest And Woodland	0.42	0.15	0.1
Casuarina Forest and Woodland	0.42	0.15	0.1
Melaleuca Forest and Woodland	0.42	0.15	0.1
Other Forest and Woodlands	0.41	0.15	0.1
Tropical Eucalypt Woodland/Grassland	0.41	0.18	0.1
Eucalypt Open Woodland	0.22	0.18	0.1
Acacia Open Woodland	0.22	0.165	0.1
Mallee Woodland and Shrubland	0.22	0.165	0.1
Low Closed Forest and Closed Shrubland	0.22	0.165	0.1
Acacia Shrubland	0.22	0.165	0.1
Other Shrubland	0.22	0.165	0.1
Heath	0	0.3	0.18
Chenopod Shrub, Samphire Shrubland, Forbland	0	0.3	0.18
Unclassified Native Vegetation	0.39	0.14	0.09

Table 1.2: Partitioning of biomass (leaves, coarse roots and fine roots)

National Vegetation Information System Major Vegetation Groups	Biomass fraction to leaves (fraction)	Biomass fraction to coarse roots (fraction)	Biomass fraction to fine roots (fraction)	Root:shoot ratio
Rainforest and Vine Thickets	0.01	0.06	0.03	0.10
Eucalypt Tall Open Forest	0.02	0.08	0.04	0.14
Eucalypt Open Forest	0.02	0.25	0.06	0.45
Eucalypt Low Open Forest	0.02	0.25	0.06	0.45
Eucalypt Woodlands	0.02	0.23	0.06	0.41
Acacia Forest and Woodland	0.02	0.25	0.06	0.45
Callitris Forest and Woodland	0.02	0.16	0.15	0.45
Casuarina Forest and Woodland	0.02	0.25	0.06	0.45
Melaleuca Forest and Woodland	0.02	0.25	0.06	0.45
Other Forest and Woodlands	0.02	0.25	0.06	0.45
Tropical Eucalypt Woodland/Grassland	0.02	0.23	0.06	0.41
Eucalypt Open Woodland	0.025	0.23	0.06	0.41
Acacia Open Woodland	0.025	0.42	0.07	0.96
Mallee Woodland and Shrubland	0.025	0.42	0.07	0.96
Low Closed Forest and Closed Shrubland	0.025	0.42	0.07	0.96
Acacia Shrubland	0.025	0.25	0.24	0.96
Other Shrubland	0.025	0.25	0.24	0.96
Heath	0.03	0.25	0.24	0.96
Chenopod Shrub, Samphire Shrubland, Forbland	0.03	0.25	0.24	0.96
Unclassified Native Vegetation	0.02	0.25	0.11	0.56

Table 2: Burn Efficiency

	Stem	Branch	Bark	Leaves	Coarse roots	Fine roots
All National Vegetation Information System Major Vegetation Groups	0.9	0.9	0.95	0.95	0.8	0.7

Table 3: Decay Rate

	Leaves	Stem	Branch	Bark	Coarse roots	Fine roots
All National Vegetation Information System Major Vegetation Groups	1	0.1	0.1	0.5	0.1	0.3

Note

1. All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003*. See <http://www.frli.gov.au>.