PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL FORM FOR EMISSION REDUCTIONS ACTIVITIES (Version 02.0)	
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Type of standard	Choose an item.
Unique reference number and title of the proposed new methodology or new methodological tool	>>
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[1] Format for footnotes.

SECTION A. Summary and applicability of the baseline and monitoring methodology or methodological tool

A.1. Title, submission date and version

Title: Savanna Fire Management (“SFM”)

Submission date: 3/10/2025

Version: 2.0

A.2. If this methodology or methodological tool is based on a previous submission or an approved Article 6.4 mechanism methodology or methodological tool, please state the reference numbers here. Explain briefly the main differences and their rationale.

>>This submission updates and supersedes an earlier “SFM” proposal to align fully with the current PACM Standards and address Initial Assessment feedback. Key revisions include:

- (i) explicit selection of the historical emissions baseline approach (RMP ¶36(iii)) with mandated downward adjustments and BAU checks;
- (ii) Investment Analysis as the default additionality route (with a gated Barrier Analysis option only where allowed);
- (iii) a clarified leakage framework focused on activity-shifting and a defined Leakage Belt with mirrored MRV; and
- (iv) a complete set of SFM-specific definitions (e.g., EDS/LDS, patchiness, leakage belt, MAR-W).

This methodology is not based on previous Article 6.4 methodology, but it is adapted from a long-standing Australian Carbon Credit Units (ACCUs) scheme methodology. Specifically, this methodology is based on the following methodologies:

Emissions Abatement through Savanna Fire Management Methodology Determination 2015, 2018 and 2024 (draft) from the Australian Carbon Credits (Carbon Farming Initiative) Act 2011 (SFM 2015, SFM 2018 & SFM 2024). Most parameters are based on the 2015 Australian SFM method (SFM 2015).

The methodology also drew informed development from:

- Lynch et al. 2018. Incentivising fire management in Pindan (Acacia shrubland): a proposed vegetation fuel type for Australia’s savanna burning greenhouse gas emissions abatement methodology. Ecological Management & Restoration 19, 230-238

- Murphy BP, Edwards AC, Meyer CP, Russell-Smith J (Eds) 2015. Carbon accounting and savanna fire management. CSIRO Publications, Melbourne.

- Russell-Smith et al. 2009. Improving estimates of savanna burning emissions for greenhouse accounting in northern Australia: limitations, challenges, applications. International Journal of Wildland Fire 18, 1-18.

- Russell-Smith et al. 2024. Framework for a savanna burning emissions abatement methodology applicable to fire-prone miombo woodlands in Southern Africa. International Journal of Wildland Fire, in press.

- Yates et al. 2015. Fuel accumulation, consumption and fire patchiness in the lower rainfall savanna region. In: Carbon accounting and savanna fire management. Murphy BP, Edwards AC, Meyer CP, Russell-Smith J (Eds), pp. 115-132. CSIRO Publications, Melbourne.

Key differences and their rationale:

The SFM methodology expands the applicability of savanna fire management to a global scale, moving beyond the Australian context of the original SFM methods. This is achieved by incorporating regional parameters and a framework for developing new parameters for other woody savanna systems.

A.3. Summary description of the methodology or methodological tool, including major baseline and monitoring methodological steps.

>>The methodology quantifies emission reductions from shifting savanna fire regimes from late dry season (LDS) to early dry season (EDS) burning.

The Baseline is set via the historical emissions approach and determined using a Historical Reference Period (HRP), followed by an initial and subsequent downward adjustments.

A conservative Business-as-usual (BAU) scenario is identified as per the Baseline Standard (including policy/target screens), to ensure that the crediting baseline of the downward-adjusted is lower than the most likely BAU.

Additionality is demonstrated by Investment Analysis (simple-cost or benchmark/comparison, as applicable), with Common Practice and Regulatory checks; a Barrier Analysis pathway is available only for narrowly defined cases.

Leakage focuses on activity-shifting of EDS/LDS fires; a Leakage Belt is monitored with the same MRV as the project area. Monitoring uses EO inputs aggregated into monthly, seasonal (EDS/LDS) and annual products; key parameters include burned area, fuel/vegetation strata, patchiness, years-since-last-burn, emission factors and combustion efficiency; QA/QC requires ≥80% mapping accuracy as a minimum.

A complete Definitions section provides clear meanings for SFM-specific terms (e.g., EDS, LDS, patchiness, leakage belt, MAR-W) to ensure unambiguous application throughout the methodology.

The Savanna Fire Management (SFM) methodology allows for quantifying the reduction of methane (CH_4) and nitrous oxide (N_2O) emissions in global woody savannas resulting from project activities that induce a shift in the fire seasonality and/or a reduction in the area burned (extent).

The methodology targets areas where, historically, frequent and intense fires, predominantly in the Late Dry Season (LDS), have led to significant Greenhouse Gas (GHG) emissions that can be reduced through improved fire management. The SFM concept incentivizes shifting the fire seasonality and/or extent of fires in a project area by using strategic Early Dry Season (EDS) prescribed burns designed to reduce emissions associated with high intensity late dry season fires (Figure 1) which were the norm historically, and likely to continue in the absence of the project.

The proposed SFM activities rely on a step-change in land management, fire prevention and fire suppression activities which brings about a permanent change in emissions (and carbon stocks) for as long as the activities continue to be undertaken. Project activities include prescribed ground and aerial burning, as well as establishing and maintaining mechanical fire breaks for property and asset protection, for fire management and road access.

The SFM methodology is centred around the definition of an 'Early Dry Season' (EDS) and a 'Late Dry Season' (LDS), each with their own set of calculation parameters to determine net CH_4 and N_2O emissions. The rest of the year in the targeted ecosystem is typically characterized as a strong Wet Season during which fires don't typically naturally occur - and are not incentivised by this methodology.

CO_2 emissions are not included because they are not significantly impacted by the seasonality of savanna fires. Furthermore, in highly seasonal savannas, the IPCC guidelines assume that the amount of CO_2 emitted during a fire season is equivalent to the amount removed from the atmosphere through vegetation regrowth in the succeeding wet season(s).

Future iterations of the methodology may offer as an option a framework for the optional accounting of carbon removal as an increase in carbon stocks in above and below ground woody tree biomass, in both live biomass and dead standing pools.

The methodology builds on previous work by Seiler and Crutzen (1980), IPCC (1997), as well as the SFM methods used in the Australian government-regulated domestic offset market (SFM 2015, SFM 2018 & SFM 2025).

The Figures below show a conceptual example of the outcomes that SFM projects seek to achieve, based on publicly available and actual data from an Australian project area.

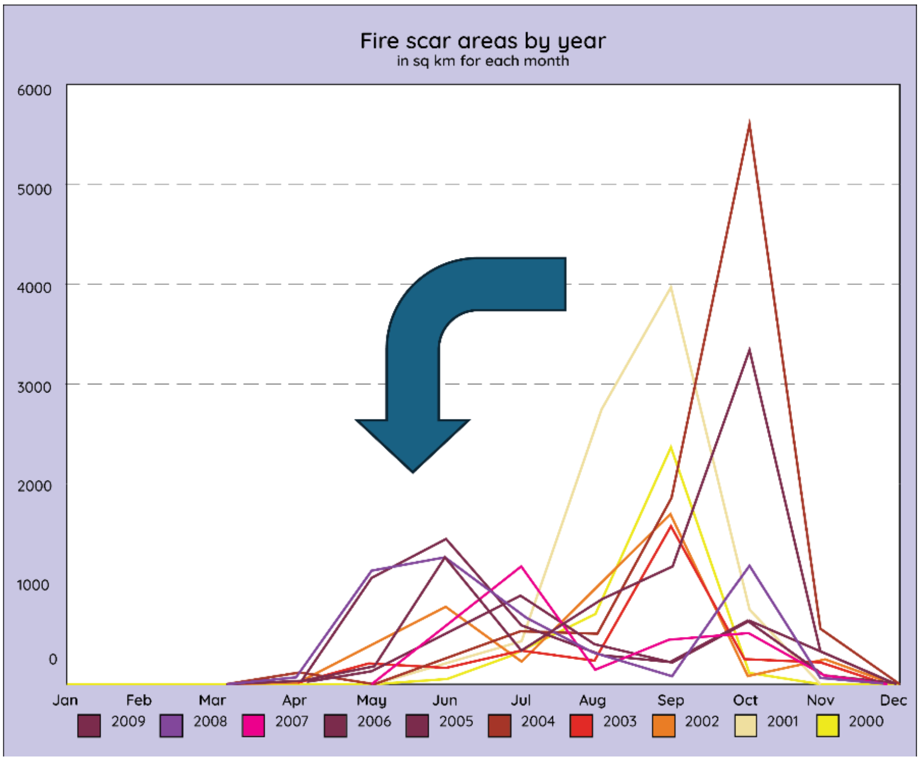

Figure 1 SFM projects aim to bring forward and flatten the fire curve from LDS to EDS

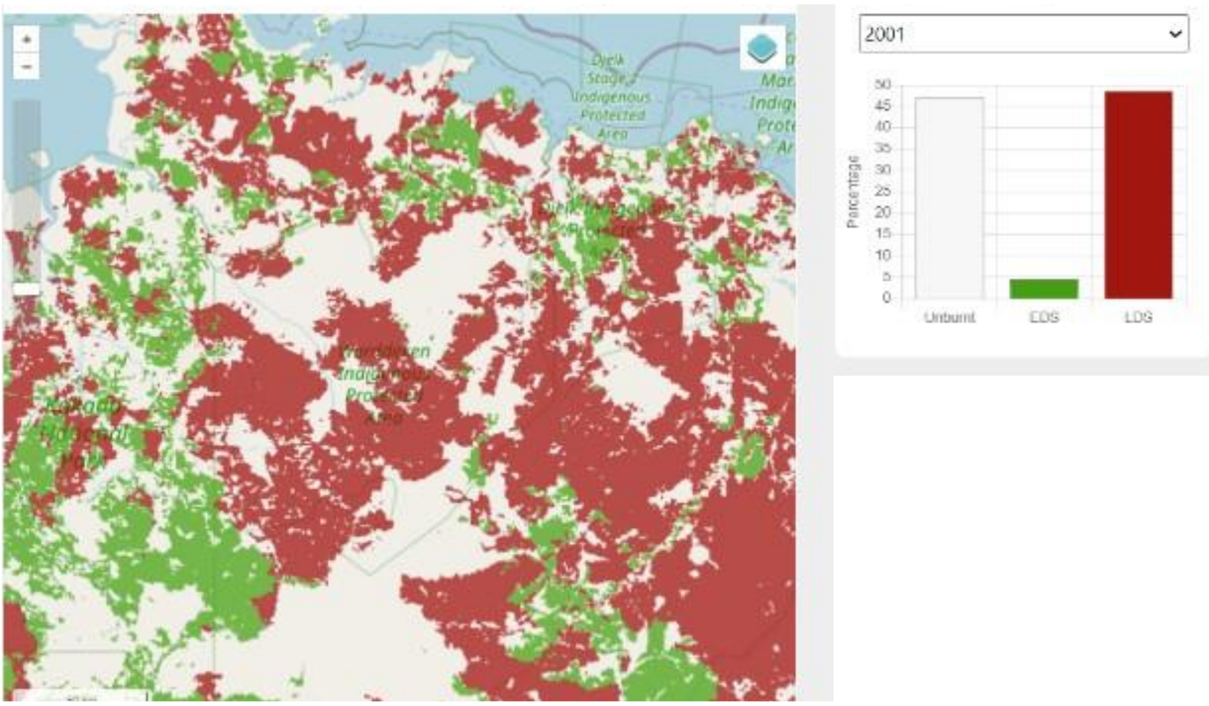

Figure 2 (BEFORE) Example of a baseline fire regime suitable for a SFM project. Top: Burned area per month showing LDS fires in 2001. Bottom: Fire seasonality map since the project started (source: www.SMERF.net,au0F)

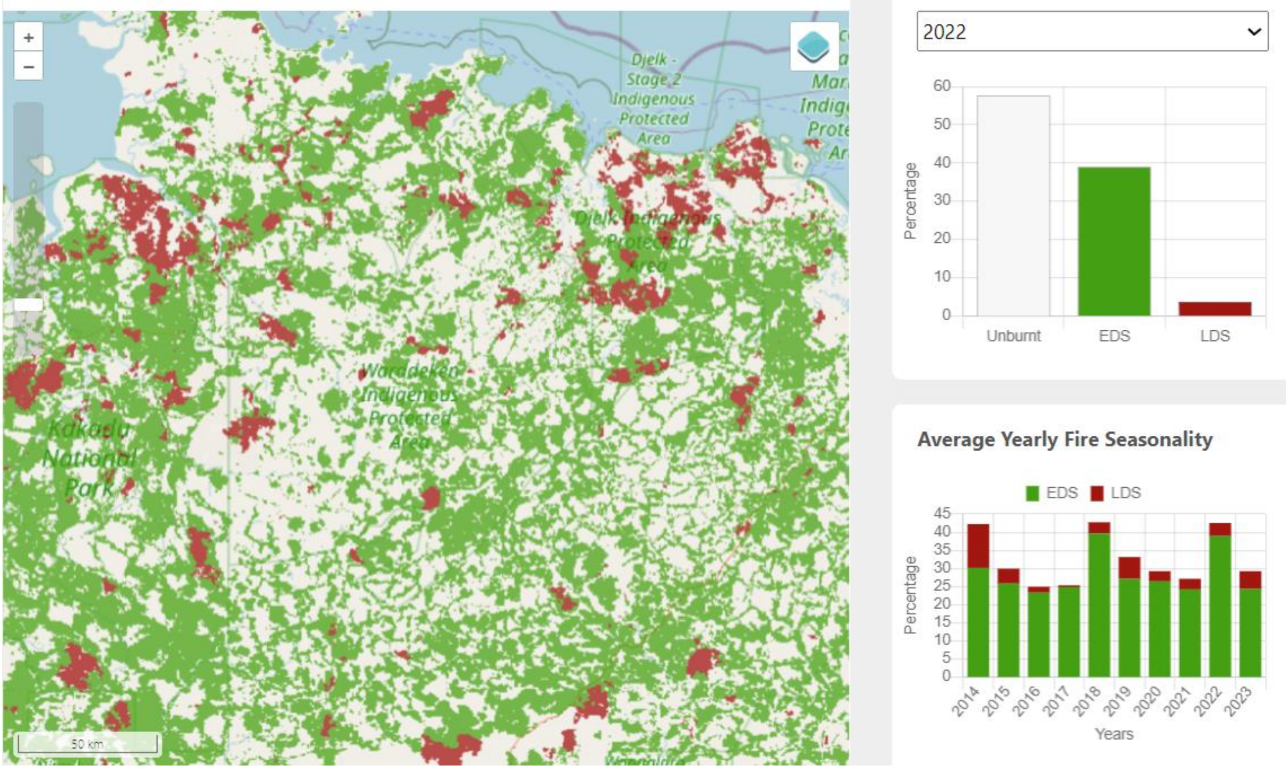

Figure 3 (AFTER) Example of fire regime for a successful SFM project. Top: Burned area per month showing less LDS fires. Bottom: Fire seasonality map (source: www.SMERF.net.au)

Major Methodological Steps:

- **Define Key Project Dates:** Determine the Start of EDS, End of LDS, and the Cut Off Date for End of EDS and Start of LDS based on regionally specific measurements and reputable climatology sources.
- **Establish Historical Reference Period (HRP):** The HRP must be a minimum of 7 years, cover at least 2 times the Mean Fire Return Interval (FRI), and a maximum of 4 times FRI or 20 years (whichever is smallest).
- **Create and Validate Vegetation Fuel Type Map:** A Vegetation Fuel Type map for the project area is created at the start of each crediting period and validated to ensure accuracy (80% or greater).
- **Calculate Baseline Emissions (BE)**: Baseline emissions for the HRP are calculated as the average annual historical emissions from fires in the project area, adjusted downwards for conservativeness and ambition, and to ensure the crediting baseline is below BAU. This involves calculating annual fire emissions stratified by fire season (EDS/LDS), time since last burned (YSLB), and vegetation fuel types, using remote-sensing data and regional/international emission factors and fuel load parameters.

Major Monitoring Steps:

- **Continuous Monitoring of Fire Events**: Monitor fire surface area (extent and seasonality) within the project area (and leakage belt if required) using digital monitoring, reporting, and verification (dMRV) systems, or through manual methods following strict guidelines for creating and validating monthly and seasonal burnt area maps.
- **Update Vegetation Fuel Type Map**: Ensure the Vegetation Fuel Type map remains accurate at each verification event and update it at the start of every crediting period or if major events occur.
- **Produce Years-Since-Last-Burned (YSLB) Maps**: Generate YSLB maps for each calendar year in the project period to determine fuel loads.
- **Calculate Project Emissions (PE):** Project emissions are calculated annually, primarily from fire emissions from eligible vegetation fuel types. Emissions from fossil fuel combustion and electricity consumption for fire management are also quantified and expected to be minimal.

- **Identify and Quantify Leakage**: Identify potential sources of leakage (primarily activity-shifting leakage) and quantify them. This may involve establishing and monitoring a leakage belt.
- **Account for Uncertainty:** Quantify uncertainty associated with emission estimates from fires (including area classification and default factors).
- **Calculate Net GHG Emission Reductions**: based on baseline emissions, project emissions, and leakage. A cumulative crediting test is applied to ensure overall emission reductions over the lifetime of the project.

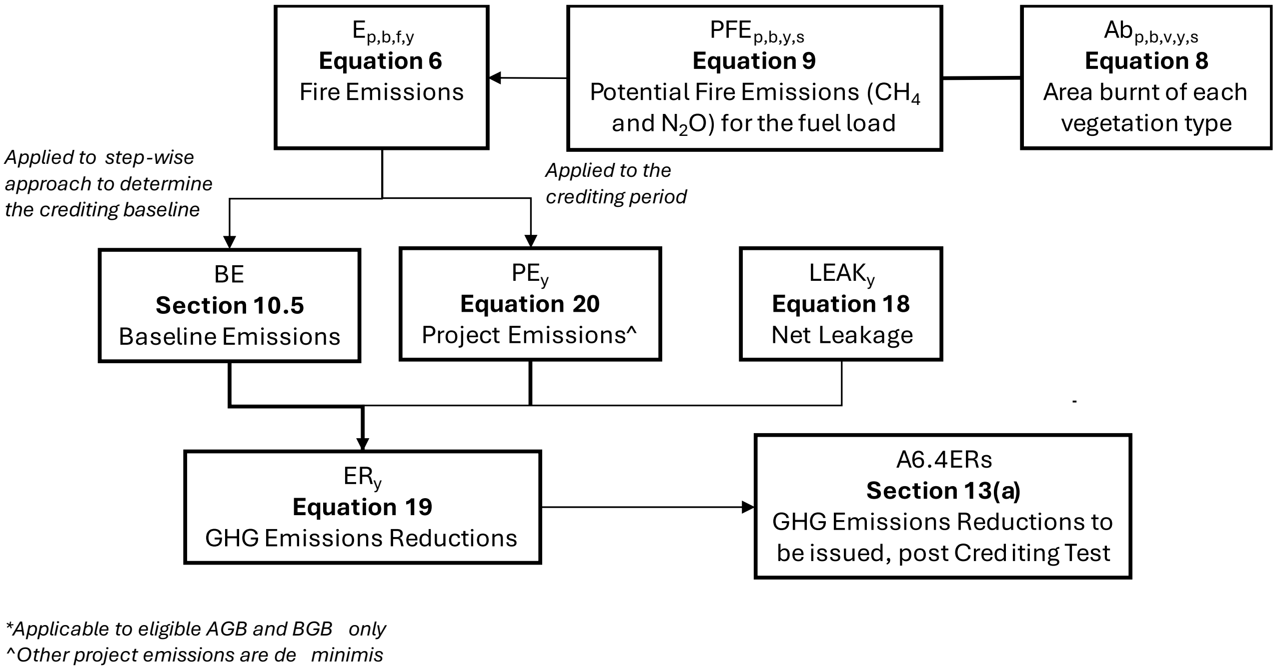

Figure 4. SFM methodology equations map

SECTION B. Proposed new baseline and monitoring methodology or methodological tool

1. Introduction

1. The following table presents a summary of the key elements of a methodology:

Table 1. Methodology key elements

Type of GHG mitigation measure(s)	☐ Fuel/feedstock switch ☐ Technology switch ☐ GHG destruction ☒ GHG formation avoidance ☐ Engineered carbon dioxide removal ☐ Nature based carbon dioxide removal - The methodology delivers emission reductions from avoided LDS fire emission by shifting fire regimes from uncontrolled Late Dry Season (LDS) wildfires to prescribed Early Dry Season (EDS) burns, the methodology avoids the formation of methane (CH_4) and nitrous oxide (N_2O) associated with more intense LDS fires**.**
Types of mitigation outcomes achieved under this methodology	☒ Emission reductions ☐ Removals While removals and ecological co-benefits (e.g., vegetation recovery, soil carbon stability) may occur, the methodology conservatively credits only emission reductions, not removals.
Are the mitigation outcomes under this methodology at risk of reversal?	☐ Yes ☒ No
Typical projects eligible under the methodology	- Fire management projects in woody savanna ecosystems within the tropical and subtropical belts. - Activities must be in regions with an extended dry season (≥4–5 months, rainfall <10% MAR-W). - Eligible projects include those implementing planned, prescribed EDS burns to reduce the frequency, size, and intensity of LDS wildfires. - Typical activity participants may include Indigenous land management groups, government agencies, conservation organizations, and private landholders. - Geographic applicability: savanna regions in Africa, South America, Asia, and Oceania, consistent with ecological conditions.

2. Scope and entry into force

2.1. Scope

1. This methodology applies to Agriculture, Forestry and Other Land Use (AFOLU) project activities that reduce greenhouse gas (GHG) emissions by modifying fire regimes in woody savanna ecosystems. Eligible ecosystems must meet the applicability conditions defined in Section 5 (Applicability), including:
   - Presence of woody savanna vegetation fuel types;
   - Extended dry seasons of at least 4–5 months, during which rainfall is <10% of the mean annual wet-season rainfall (MAR-W); and
   - Compliance with host-country legal, regulatory, and tenure frameworks for fire management.

   The methodology specifically covers activities where prescribed Early Dry Season (EDS) burning reduces the frequency, intensity, and extent of Late Dry Season (LDS) wildfires, resulting in net reductions of CH_4 and N_2O emissions from biomass combustion.

   The methodology does not apply to:
   - Pure grasslands, shrublands, wetlands, or croplands that lack woody savanna fuel structures and/or where a change of fire regime is ecologically detrimental (e/g/ woody encroachment in arid savanna grasslands);
   - Land-use conversion or afforestation/reforestation activities;
   - Projects seeking crediting from carbon sequestration in biomass, soils, or harvested wood products. While co-benefits from carbon sequestration may arise, they are not included in the current accounting framework and may be addressed in future iterations of the methodology.

   The scope includes the project activity area and, where relevant, a Leakage Belt (LB) defined in Section 12. The Leakage Belt ensures that potential displacement of EDS/LDS fire emissions is monitored and conservatively deducted.

   Relevant greenhouse gases included in this methodology are:
   - Methane (CH_4) and Nitrous Oxide (N_2O) from savanna fire combustion;
   - Carbon dioxide (CO_2) emissions from project fossil fuel use (vehicles, aerial operations);
   - Biogenic CO_2 from biomass combustion is excluded as it is assumed to be reabsorbed in subsequent wet-season regrowth (consistent with IPCC 2006 Guidelines for AFOLU).

   By defining a clear ecological and functional scope, this methodology ensures that credited outcomes are attributable to the change in fire regime (from predominantly uncontrolled large and intense fires in the Late Dry Season (LDS) to controlled low intensity fires in the Early Dry Season (EDS) within eligible woody savanna ecosystems (only), where such change in fire regime is ecologically beneficial (only).

2.2. Entry into force

[For the UNFCCC secretariat to complete - Leave blank]

2.3. Applicability of sectoral scopes

2. Designated operational entities validating and verifying Article 6.4 activities that use this methodology shall apply sectoral scope(s):

   [For the UNFCCC secretariat to complete – leave blank]

3. Definitions

3. In addition to the definitions contained in the ‘Article 6.4 mechanism Glossary of Terms’, the following definitions apply for the purpose of this methodology.

The methodology provides SFM-specific definitions used in eligibility, baseline, leakage and MRV. The definitions set includes, inter alia: Early Dry Season (EDS), Late Dry Season (LDS), patchiness, leakage belt, Mean Annual Rainfall – Wet season (MAR-W), fire return interval (FRI), vegetation fuel type (VFT), fuel surface area (FSA), years since last burn (YSLB), combustion efficiency, emission factor, and related terms:

(a) **Coarse fuel**: Vegetation fuel comprising dead twigs and branches of not less than 6 millimeters in diameter and not more than 50 millimeters in diameter.

(b) **Canopy Cover**, or ‘approximate crown cover' is the percentage of a sample site within the vertical projection of the periphery of the tree crowns. The crowns are treated as 'opaque' (i.e. if there are patches of sky visible within the tree crowns when the observer looks from below, these patches are considered part of the crown, and are included in the cover value).

(c) **Combustion Efficiency:** The fraction of the available biomass fuel that is combusted during a fire event, expressed as a unitless coefficient used in emissions calculations.

(d) **Cured Fuel**: Vegetation that is sufficiently dry to burn. Curing is a measure of ‘greenness’ and affects moisture content of fuels, ignition potential, fire intensity and rate of spread of fires.

(e) **Early Dry Season (EDS):** The portion of the dry season following the end of wet-season rains, when fuel is fully cured, but when atmospheric conditions are still relatively cold with high dew point (especially overnight), which ensures that prescribed burns are typically cooler, patchier, and lower in intensity, and self-extinguish because of the residual moisture.

(f) **Eligible Savanna Vegetation Fuel Types**: Woody savanna ecosystems meeting the applicability conditions of the methodology, typically defined by canopy cover, vegetation structure, fuel size and rainfall regime.

(g) **Emission Factor (EF):** A coefficient that quantifies the amount of a given greenhouse gas released per unit of biomass combusted, expressed in grams of gas per kilogram of dry matter burned.

(h) **Fine Fuel**: Vegetation fuel comprising grass, leaf litter, bark and dead small twigs of less than 6 millimetres in diameter.

(i) **Fire Regime**: The set of parameters used to define the average behaviour of fire in eligible savanna ecosystems, and its long-term impact on carbon pools and sources of emissions.

(j) **Fire Return Interval (FRI):** The average number of years between successive fires occurring in a given area, typically expressed as a range. Used in determining the length of the Historical Reference Period.

(k) **Fuel Load:** The amount of biomass, expressed in dry mass per unit area (e.g., tonnes per hectare), available for combustion in a given vegetation fuel type.

(l) **Fuel Size Class:** The vegetation fuel belonging to a given size class, being Fine fuel, Coarse fuel, Heavy fuel, Shrub fuel, or Ineligible fuel.

(m) **Fuel Surface Area (FSA)**: The area of vegetation fuels available to burn in a given year, stratified by vegetation fuel type, season, and years since last burn.

(n) **Heavy Fuel**: Vegetation fuel comprising dead branches and dead logs lying on the ground greater than 50 millimetres in diameter.

(o) **Historical Reference Period (HRP):** The number of years immediately prior the start of the project which is used in the calculations of the Baseline Emissions that will be avoided by the project, and is determined in accordance with section 10 - Baseline Scenario.

(p) **Late Dry Season (LDS):** The portion of the dry season prior to the onset of the wet season, when vegetation fuels are driest, atmospheric conditions are relatively hot, windy and with a low dew point, and when wildfires tend to be hotter, more intense, and more extensive.

(q) **Leakage Belt:** A designated area surrounding the project boundary as defined in section 12, used to monitor potential displacement of EDS/LDS fires and quantify activity-shifting leakage.

(r) **Mean Annual Rainfall – Wet season (MAR-W):** The total rainfall received during the wet season, used as a reference to define applicability conditions for project areas; the dry season is considered extended if cumulative rainfall is less than 10% of MAR-W.

(s) **Mosaic Burning:** A fire management technique in which burns are conducted to create a patchwork of burned and unburned areas, increasing fire heterogeneity and reducing the risk of large, intense wildfires.

(t) **Patchiness**: A measure of the proportion and spatial distribution of vegetation burned within a fire scar, reflecting incomplete combustion and the mosaic of burned and unburned areas.

(u) **Prescribed Burning:** The deliberate, planned use of fire under controlled conditions to achieve specific ecological, cultural, or emissions-reduction objectives, typically conducted in the EDS.

(v) **Project start date:** Commonly defined as the date on which the emissions reduction activities start. For SFM projects, calculations can only be made annually, and the project's start date is therefore:

- For SFM projects in the southern hemisphere, the 1st of January of the year that is selected to commence fire management operations in the Early Dry Season.

- For SFM projects in the northern hemisphere, or if proponents decide to determine their own End of the Historical reference period date, then the day immediately after the End of the Historical reference period.

(w) **Savanna:** Vegetation type that grows under hot, seasonally dry climatic conditions and is characterised by an open tree canopy (i.e., scattered trees) above a largely continuous tall grass understory (the vegetation layer between the forest canopy and the ground). This methodology specifically targets those Savanna landscapes with higher woody cover, and higher mean annual rainfall (see Figure 4 and the Savanna Boundary Shapefile).

(x) **Savanna Boundary Shapefile:** Supporting shapefile containing the indicative applicable savanna boundary.

(y) **Savanna Fire Management (SFM)**: A land management practice that reduces greenhouse gas emissions by shifting fire regimes from late dry season (LDS) wildfires to earlier, cooler, and more controlled early dry season (EDS) prescribed burns.

(z) **Shrubs**: A woody plant, typically less than 8 meters tall. Unlike a tree, shrubs have several stems.

(aa) **Vegetation Fuel Type (VFT)**: A classification of vegetation communities based on their fuel characteristics (e.g., woody savanna, shrub savanna), which determines their fire behaviour and associated emission factors.

(bb) **Waypoint:** A point in geographical space where information is collected, which is defined by a set of coordinates.

(cc) **Waypoint buffer**: A circular area with a radius of 100 meters that surrounds a waypoint.

(dd) **Years Since Last Burn (YSLB):** A measure of the time elapsed, in years, since a given patch of vegetation was last burned, used to model fuel accumulation and fire behaviour.

4. Normative references

4. This proposed baseline and monitoring methodology is based on the following proposed new methodologies and/or approved or consolidated methodologies:

(a) Australian Carbon Credit Unit (ACCU) Scheme – Savanna Fire Management Methodology (2015, 2018, Exposure Draft 2025), developed under the Emissions Reduction Fund (ERF) and the Carbon Farming Initiative (CFI). This provides the conceptual and technical foundation for shifting fire regimes from the late dry season to the early dry season.

(b) UNFCCC CDM Methodologies for fire management in grasslands and savannas (where applicable, consolidated versions). While not directly transferable, these provide precedent for accounting for fire-related emissions in AFOLU contexts.

5. This methodology also refers to the latest approved versions of the following methodological tools:

(a) A6.4-STAN-METH-004: Baseline Standard – for setting historical emissions baselines, downward adjustment, and BAU screening.

(b) A6.4-STAN-METH-003: Additionality Standard – for Investment Analysis, Common Practice Analysis, and regulatory surplus tests.

(c) A6.4-STAN-METH-005: Leakage Standard – for identification of leakage sources, and quantification of activity-shifting leakage via a leakage belt.

(d) 2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2019 Refinement, Volume 4 (AFOLU), which provide default equations, emission factors, and guidance for estimating emissions from biomass burning.

(e) Methodological guidance on the use of remote sensing (e.g., MODIS, Sentinel-2, Landsat) as referenced in IPCC good practice and as incorporated into national GHG inventories.

6. This methodology is based on the following sources of information:

(a) Scientific literature on savanna fire management in northern Australia (e.g., Russell-Smith et al., 2009; Murphy et al., 2014; Bowman & Legge, 2016), which demonstrate the emissions abatement potential of shifting fire regimes.

(b) Case studies and program evaluations from Australian Indigenous ranger groups (e.g., West Arnhem Land Fire Abatement project, Arnhem Land Fire Abatement Ltd., and subsequent ACCU projects), which provide empirical evidence of operational feasibility and co-benefits.

(c) Regional studies in Africa and South America (e.g., Franke et al., 2024 on prescribed burning in the Brazilian Cerrado; Lekoko et al., 2024 on fire management in Botswana's Chobe District), which support the transferability of the methodology to other savanna biomes.

(d) Climate and ecological datasets, including rainfall (MAR-W), vegetation fuel maps, and fire history derived from satellite remote sensing (MODIS MCD64A1 burned area, Sentinel-2, Landsat archives).

(e) PACM Standards and Procedures (A6.4-STAN-METH-001 through -006; A6.4-PROC-METH-001), which set the normative requirements for methodology development, baseline setting, additionality, and leakage.

5. Applicability

7. This methodology is applicable under the following conditions. Each condition specifies the timing of assessment (whether assessed once at validation or reassessed at each verification or crediting period renewal), and the evidence required to demonstrate compliance, in accordance with Appendix 1, section 1 of the Baseline Standard:

(a) **(Eligible ecosystems)** Project activities must be located within woody savanna ecosystems that fall within the envelope of globally applicable savannas, as defined by vegetation structure, canopy cover, and fire-prone fuel characteristics. Projects can only be implemented in woody savanna systems for which the relevant parameters are available or can be developed using the procedure in the methodology appendix.
   (i) Timing of assessment: Initial Validation (only).
   (ii) Evidence required: Vegetation Fuel Type (VFT) map of the project area (accuracy ≥80%), cross-checked against the indicative Savanna Boundary Shapefile supplied with the methodology.
   (iii) References: Remote-sensing products such as MODIS MCD12Q1 (v6) land cover and Sentinel-2 vegetation indices. Scientific references: Russell-Smith et al. (2009), Murphy et al. (2015, CSIRO), Yates et al. (2015). or subsequent and similar published in the *International Journal of Wildland Fire.*

(b) **(Exclusions)** The methodology is not applicable to grasslands, non-woody savannas, permanent water bodies, croplands, or urbanized areas. These exclusions prevent misapplication to ecosystems where fire dynamics and emissions reduction potential differ materially.
   (i) Timing of assessment: Initial Validation (only).
   (ii) Evidence required: Geospatial analysis of project polygons against land cover datasets (e.g., MODIS MCD12Q1, national land-cover maps, or FAO Global Ecological Zones).
   (iii) Reference: Reference: IPCC 2006 Guidelines for AFOLU (Vol. 4, Ch. 2).

(c) **(Seasonality)** Eligible project areas must experience an extended annual dry season lasting at least 4–5 months, during which cumulative rainfall is less than 10% of the mean annual rainfall of the wet season (MAR-W). This ensures that projects are only implemented in regions where fire seasonality is ecologically and climatically significant.

(i) Timing of assessment: Initial Validation (only)

(ii) Evidence required: Climatic datasets (e.g., ERA5-Land(2003-present), CHIRPS v2.0) demonstrating compliance with MAR-W thresholds over the Historical Reference Period.

(iii) Reference: Peer-reviewed justification of thresholds: Russell-Smith et al. (2009), Franke et al. (2024, Cerrado fires) or subsequent and similar published in the *International Journal of Wildland Fire.*

(d) **(Project activities)** Projects must aim to reduce the emission of methane and nitrous oxide from fire in eligible Vegetation Fuel Type pools by shifting the seasonality and/or reducing the extent of fire, primarily by implementing prescribed burns in the Early Dry Season (EDS).

(i) Timing of assessment: Each Verification

(ii) Evidence required: Project design documentation and operational plans describing intended fire management practices.

(iii) Reference: National fire management guidelines or peer-reviewed literature (e.g., Seiler & Crutzen 1980; Russell-Smith et al. 2024), or subsequent and similar published in the *International Journal of Wildland Fire.*

(e) **(Legal and regulatory compliance)** Activity participants must demonstrate tenure or rights to implement the activity (land ownership, customary rights, leasehold, or equivalent documentation). Projects are only eligible if they go beyond existing legal or regulatory requirements. Activities are not eligible where host-country law or regulation already mandates prescribed burning, the shift of fire regimes from LDS to EDS, or equivalent fire management practices.

(i) Timing of assessment: Each Verification

(ii) Evidence required: Land tenure records, leasehold titles, or community agreements; citations of relevant national or subnational fire management legislation;

(iii) Reference: host Party NDA attestation confirming no overlap with mandatory requirements, and A6.4-STAN-METH-003 (Additionality Standard, §6.1, para. 24–27).

(f) **(Leakage avoidance or minimisation – project activities)** The implementation of project activities must seek to avoid, and where not possible, minimise negative leakage by keeping EDS prescribed fires within the project area, primarily by not burning outside the project boundary and establishing boundary fire breaks.

(i) Timing of assessment: Each Verification.

(ii) Evidence required: Project design documentation and operational plans describing intended fire management practices.

(iii) Reference: National fire management guidelines or peer-reviewed literature (e.g., Seiler & Crutzen 1980; Russell-Smith et al. 2024), or subsequent and similar published in the *International Journal of Wildland Fire,* and A6.4-STAN-METH-005 (Leakage Standard, §5.2(c)).

(g) **(Re-assessment of applicability)** All applicability conditions that depend on ecological (vegetation type, rainfall thresholds) or legal/regulatory factors shall be reassessed at the renewal of each crediting period, in line with Appendix 1, Section 1 of the Baseline Standard.

(i) Timing of assessment: At each crediting-period renewal.

(ii) Evidence required: Updated datasets as in (a)–(f) above, plus confirmation of continued legal rights and regulatory conditions.

This methodology is not applicable under the following conditions:

(a) **(Livestock Intensification)** Project activities involving solely an increase in livestock stocking density within the project area (e.g. cattle).

(b) **(Clearing of Vegetation)** Activities focused on clearing vegetation (e.g., extending croplands, harvesting fuelwood or timber, or extracting any kind of woody biomass).

(c) **(Ineligible Ecosystems)** Project activities located outside eligible woody savanna ecosystems (e.g., grasslands, non-woody savannas, extratropical steppes or prairies). A narrow exception may be made where the project area falls within a minority subzone of a wider eco-region that can be demonstrably assimilated to woody savanna, subject to host Party and DOE validation.

8. **Explanatory Notes**

- Ecological rationale: Limiting eligibility to woody savannas aligns with the ecological processes underpinning savanna fire management, where shifting fire regimes delivers measurable GHG mitigation.
- Exclusions: Excluding grasslands and croplands prevents overlap with agricultural methodologies and ensures consistency with PACM safeguards. It also ensures that the methodology is **not** applied in naturally occurring grasslands or ecosystems where EDS burns may lead to undesirable ecological impacts such as woody encroachment, or damage to riparian forests.
- Climatic thresholds: The dry season definition (≥4–5 months, <10% MAR-W rainfall) is derived from the Australian SFM methodology and supported by African and Brazilian studies demonstrating strong seasonality of fire emissions.
- Legal compliance: Ensures that projects do not generate credits for activities already required by law, addressing Secretariat concerns about regulatory overlap.
- Re-assessment: Requiring periodic reassessment ensures continued eligibility and compliance over time.

Figure 4 below provides an outline of the global geographical distribution of eligible woody savannas under this methodology, also supported by the Savannas Boundary Shapefile. Each project must make its own assessment for its own Project Area and submit its own datasets to demonstrate eligibility.

To derive the below areas, the IGBP classification (MODIS MCD12Q1, Version 6) was used to group land cover types (classes 6–10: temperate shrublands, grasslands, woody/open savanna, tropical grasslands) into a “savanna and grassland biome.” Savannas were then categorized by rainfall using ERA5 data (2003–2020), using the following categories: Water; Non-savanna land; High rainfall savannas (>1000 mm/yr); Low rainfall savannas (600-1000 mm/yr); Arid savannas (400-600 mm/yr); and Extra-tropical grasslands. Extratropical grasslands (e.g., prairies, pampas, steppes) were excluded by limiting the scope to subtropical regions (35°N–35°S).

Finally, this Savanna layer was intersected with an analysis based on global rainfall data, to identify and retain only those areas where less than 10% of rain falls during the driest consecutive 5 months.

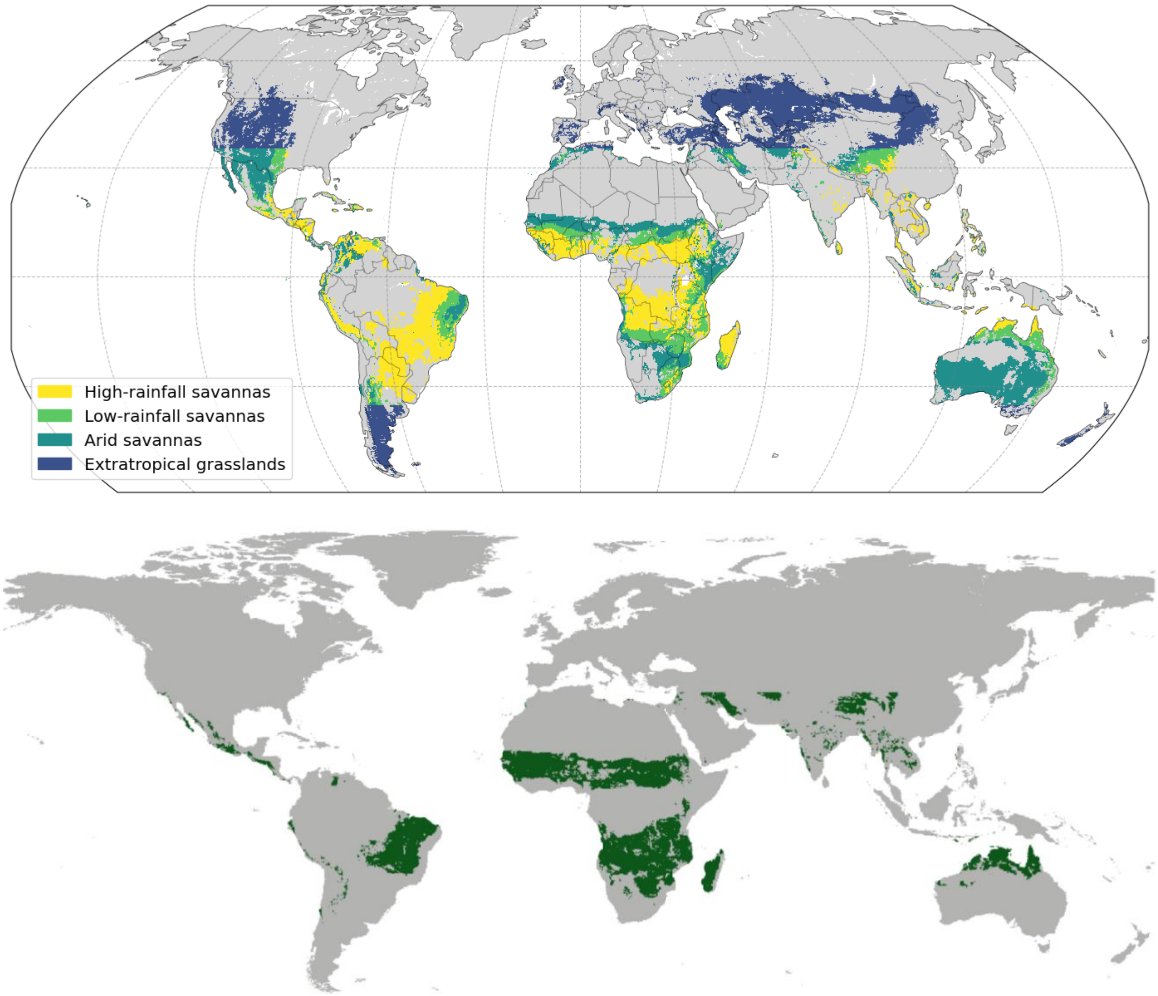

Figure 5 Indicative map of eligible woody savannas where this methodology is applicable

Major sources of data or information:

- Australian Carbon Credits (Carbon Farming Initiative) Act 2011 (SFM 2015, SFM 2018 & SFM 2024).
- IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 – AFOLU guidelines (2006 IPCC Guidelines).
- Remotely sensed data for fire extent and seasonality, and vegetation type mapping.
- ERA5-Land dataset of the Copernicus Climate Change Service (for MAR-W data in Miombo region).
- IGBP classification (MODIS MCD12Q1, Version 6) (for global savanna distribution mapping).
- Peer-reviewed scientific literature, including works by:

- Lynch et al. 2018. Incentivising fire management in Pindan (Acacia shrubland): a proposed vegetation fuel type for Australia's savanna burning greenhouse gas emissions abatement methodology. Ecological Management & Restoration 19, 230-238

- Murphy BP, Edwards AC, Meyer CP, Russell-Smith J (Eds) 2015. Carbon accounting and savanna fire management. CSIRO Publications, Melbourne.

- Russell-Smith et al. 2009. Improving estimates of savanna burning emissions for greenhouse accounting in northern Australia: limitations, challenges, applications. International Journal of Wildland Fire 18, 1-18.

- Russell-Smith et al. 2024. Framework for a savanna burning emissions abatement methodology applicable to fire-prone miombo woodlands in Southern Africa. International Journal of Wildland Fire, in press.

- Yates et al. 2015. Fuel accumulation, consumption and fire patchiness in the lower rainfall savanna region. In: Carbon accounting and savanna fire management. Murphy BP, Edwards AC, Meyer CP, Russell-Smith J (Eds), pp. 115-132. CSIRO Publications, Melbourne.

6. Avoidance of double-counting

9. The This methodology ensures that double counting is systematically avoided in line with Appendix §8 of the Baseline Standard, which requires identification of double-counting risks and inclusion of provisions to avoid them across: (a) overlapping claims between crediting activities, (b) overlaps with mandatory domestic mitigation schemes, and (c) overlaps with other frameworks or environmental markets. It is also consistent with the Methodologies Standard principles on transparent monitoring and data controls.

(a) **Core controls (applicable to all SFM activities)**

(i) *Project boundary definition.* Project boundaries shall be submitted as georeferenced polygons (shapefile/GeoJSON) and verified against authoritative national datasets (e.g., cadastre, land-tenure, protected-area and government fire-management maps).

(ii) *Host Party authorization*. Proponents shall obtain written authorization from the host Party confirming consistency with the NDC and that the same mitigation outcomes are not being simultaneously claimed elsewhere in the national system.

(iii) *Exclusivity of registration*. Proponents shall demonstrate that the same activity area and mitigation outcomes are not concurrently registered or credited in any other mechanism or program, by providing registry extracts and validated geospatial files for cross-checks.

(iv) *Unique identification.* Each activity shall use a unique ID linked to its geofenced boundary for tracking in the Article 6.4 registry and the host Party's national system.

(v) *Reduction/removal distinction.* Proponents shall demonstrate that emission reductions credited under this methodology are not simultaneously accounted for as removals in biomass or soil pools under any other activity within the same area and period.

(b) **Overlap-screening algorithm and pass/fail rules**

(i) *Step 1 – Spatial overlap with other crediting activities.* Compile a reference layer stack including Article 6.4 registered activities; host-Party program/registry footprints; other crediting programs (voluntary/regulatory) in the host country; removals/AFOLU footprints; and any jurisdictional or nested programs. Intersect the project polygon with each layer. Flag any intersection ≥ 0.5 ha or ≥ 0.1% of the project area (whichever is smaller).

a. Undertake a risk classification:

i. **Same outcomes, same area/period** (e.g., two activities claiming the same fire-emissions reductions): **Fail** unless remedied

ii. **Upstream/downstream overlaps** in sources/pools (e.g., an avoided-deforestation activity and an SFM activity both claiming overlapping reductions): **Fail** unless disaggregated or remedied.

iii. **Different aggregation levels** (e.g., project within a jurisdictional program): **Fail** unless a binding allocation or nesting agreement is in place.

b. The Project will 'Pass' the test on the condition that no spatial overlap is flagged. or that a documented remedy (e.g., carve-out or allocation agreement) validated by the DOE and recognized by the host Party is in place.

c. The Project will 'Fail' the test for any flagged overlap without an approved remedy.

(ii) *Step 2 – Overlap with mandatory domestic mitigation schemes.* Screen for coverage by mandatory schemes (e.g., ETS, sectoral caps, performance standards) within the boundary/sector.

a. The Project will 'Pass' the test on the condition that it is excluded from such scheme, or that credits are not issued for the portion subject to the scheme; or

b. The Project will 'Pass' the test on the condition that it can prove that measures ensuring impacts are not counted toward the mandatory scheme's targets (e.g., cancellation of allowances/units equivalent to the credited outcomes before issuance).

c. The Project will 'Fail' the test if it is covered by such schemes with no exclusion or proof of measures as listed above are in place.

(iii) *Step 3 – Overlap with other frameworks or environmental markets.* Identify other frameworks/markets in which mitigation outcomes could be claimed (e.g., low-carbon fuel standards, other environmental markets).

a. The Project will 'Pass' the test on the condition that it is excluded from such scheme, or that credits are not issued for the portion subject to the scheme; or

b. The Project will 'Pass' the test on the condition that it provides a declaration and evidence that the same mitigation outcomes are not claimed in the other market/framework. Note that overlaps with non-mitigation outcomes (e.g., biodiversity credits, social impacts) are not in scope of double counting.

c. The Project will 'Fail' the test if there is evidence of double claims of the same mitigation outcomes.

(c) **Documentary evidence and registry reconciliation**

(i) Overlap-screening dossier. Submit GIS intersection reports, maps highlighting any overlaps, and a statement of pass/fail.

(ii) Registry extracts. Provide dated extracts from the Article 6.4 registry, the host Party registry/system, and other relevant registries, showing the activity is not double-listed and that any remedies (e.g., allowance cancellations) are recorded.

(iii) Host Party confirmation. Provide the host Party's confirmation that the mitigation outcomes authorized for A6.4 use are not simultaneously claimed elsewhere in the national system.

(iv) Timing and updates. Perform overlap screening at validation and before each issuance, and update immediately if boundaries change or if new domestic schemes/programs commence during the crediting period.

(v) Methodology–monitoring linkage. Maintain the data and parameters required for these checks in the monitoring plan (consistent with the Methodologies Standard provisions on monitoring and data listing).

(d) **Remedies where overlap is detected**

(i) Spatial carve-out. Permanently exclude overlapping polygons from the project area and adjust baseline/monitoring accordingly.

(ii) Allocation agreement (nested/jurisdictional cases). Where overlaps occur across aggregation levels, obtain a binding agreement between the relevant entities, endorsed by the host Party, that allocates claims unambiguously (e.g., spatial or quantitative split).

(iii) Non-issuance. Do not issue Article 6.4 ERs for any portion subject to unresolved overlaps.

(iv) Mandatory scheme interaction. For overlaps with mandatory schemes, either exclude the affected portion from issuance or document the cancellation of allowances/units equivalent to the credited outcomes before issuance

(v) Other frameworks/markets. For overlaps with other frameworks, either exclude the affected outcomes from issuance or provide evidence that the same mitigation outcomes are not claimed in those frameworks.

10. Explanatory notes:
- The controls in this section prevent duplicate claims to the same mitigation outcomes across overlapping projects, domestic schemes, and other frameworks.
- Georeferenced project polygons and unique IDs enable deterministic spatial checks against other credited areas and jurisdictional programs.
- Host Party authorization and exclusivity of registration ensure that outcomes authorized for Article 6.4 use are aligned with the NDC and are not claimed elsewhere in the national system.
- The overlap screening applies conservative pass/fail rules: any flagged spatial, programmatic, or market overlap must be resolved through an approved remedy before issuance.
- Registry reconciliation creates a verifiable audit trail by requiring dated extracts from the Article 6.4 registry, the host-party registry, and any other relevant registries.
- Clear separation of reductions and removals prevents double issuance across methodological scopes within the same area and period.
- Remedies are predefined and unambiguous, including spatial carve-outs, nesting/allocation agreements, or non-issuance for the overlapping portion.
- Screening and reconciliation are performed at validation and again before each issuance, with immediate updates if boundaries or domestic schemes change.

7. Demonstration of alignment with the policies, options and implementation plans with regard to the NDC and LT-LEDS of the host Party and the long-term temperature goal of the Paris Agreement and long-term goals of the Paris Agreement

11. Activity participants shall provide to the DOE responsible to perform the validation of the Article 6.4 project an assessment, undertaken by the DNA of the host Party, of the activity's consistency with Decision 3/CMA.3 paragraph 40 (c) and paragraph 27 (a) as part of the host Party's approval. As required by the Methodologies Standard §4.4, paras 31–33:

(a) *Application of DNA conditions*. The methodology requires activity participants to apply any conditions specified by the host Party's DNA that relate to the equitable sharing of mitigation benefits between participating Parties, and to evidence such application in the PDD and at each monitoring report (MR).

(b) *Estimation of host-Party benefits*. The methodology requires activity participants to estimate, report, and justify the mitigation benefits accruing to the host Party, including, as applicable:

(i) the host Party's share of mitigation outcomes retained domestically (e.g., share of A6.4ERs not authorized for ITMO use); and/or

(ii) (ii) qualitative and quantitative benefits that tangibly support the host Party's NDC and long-term strategies. The estimate shall be presented in the PDD and updated in each MR.

(c) *Sustainable development linkage.* The methodology requires activity participants to apply the Article 6.4 SD Tool (or successor) to demonstrate that the sharing of mitigation benefits tangibly supports the host Party's sustainable development objectives, and to document the indicators/verification used.

(d) The activity shall not constrain, but align with host Party policies, options, and implementation plans under the latest NDC or LT-LEDS.

8. Activity Boundary

12. The spatial, greenhouse gas, and regulatory activity boundaries are defined as follows:

(a) **Spatial boundary:**
- The spatial extent of the activity boundary encompasses the delineated project area polygons where Savanna Fire Management (SFM) is implemented. Eligible lands are those containing woody savanna vegetation fuel types, within the envelope of globally applicable woody savannas as recognized in the literature and IPCC classifications. The boundary explicitly excludes grasslands, non-woody savannas, permanent water bodies, croplands, and urban areas to ensure ecological consistency and to avoid misapplication of the methodology.
- Projects must be located in regions experiencing an extended dry season of at least 4–5 months, during which cumulative rainfall is <10% of the mean annual wet season rainfall (MAR-W). This condition ensures that the fire dynamics are representative of ecosystems where shifting fire regimes from the late dry season (LDS) to early dry season (EDS) materially influences greenhouse gas (GHG) outcomes.
- The activity boundary is defined at the methodology level (setting generic conditions for all eligible projects), while project-specific boundaries will be delineated at the activity level during validation.

(b) **Greenhouse gas boundary:** The methodology accounts for the following GHGs from biomass burning and project operations, consistent with the IPCC and PACM requirements:
- Carbon dioxide (CO_2): Non-biogenic fraction from biomass combustion in savanna fires and direct fossil fuel use in project operations.
- Methane (CH_4): From incomplete combustion of biomass in savanna fires.
- Nitrous oxide (N_2O): From biomass combustion in savanna fires.
- Other Kyoto gases (HFCs, PFCs, SF_6, NF_3) and upstream/downstream fossil fuel life-cycle emissions are excluded as immaterial, consistent with the conservativeness provisions of the Methodologies Standard (Section 4.2).
- All other sources of emissions from other anthropogenic activities (e.g. livestock emissions) are excluded on the assumption that they would not be impacted by a change in fire regime.

(c) **Regulatory and Legal Boundaries:** To ensure that project activities are implemented within a robust legal framework, the activity boundary shall also include regulatory and tenure boundaries, in addition to spatial and GHG boundaries:
- (Host-country tenure requirement) At the project validation stage, activity participants must demonstrate the legal right to carry out fire management activities within the delineated project area. Acceptable evidence includes: Land ownership or leasehold titles; Customary or community tenure rights recognized under national law; Formal agreements with landholders or indigenous custodians.
- (Burning permits and authorizations) Where national or subnational regulations require fire permits, environmental clearances, or protected-area management authorizations, activity participants s must provide valid documentation

demonstrating compliance. These documents must be renewed or reconfirmed at each crediting period renewal.

- (Consistency with regulatory frameworks) Project participants must confirm that no mandatory national or local laws already require SFM practices (e.g., compulsory EDS burning programs). Where such requirements exist, the project activity shall not be considered additional (see Section 9.1).
- (Validation requirement) Proponents will need to provide host-country specific datasets and legal evidence (e.g., land tenure records, burning permits, environmental regulations) at the PDD validation stage. This ensures that the applicability conditions of the methodology are not only ecological and climatic, but also legally substantiated.

(d) **Sources and reservoirs (SSR) table:** The boundary includes sources, sinks, and reservoirs of GHGs within the project area and leakage belt, as summarized in Table 2 below to ensure transparency and consistency with Appendix 1, Section 2 of the Baseline Standard.

13. **Explanatory Notes**

- **Methodology vs. project-level boundary**: The methodology defines the generic applicability and boundary conditions (eligible vegetation, climatic thresholds, GHGs included/excluded). At the project level, participants must delineate polygons, confirm vegetation stratification, and provide rainfall datasets. This distinction complies with A6.4-STAN-METH-001 requirements on methodology-level provisions

- **Conservativeness and credibility:** By including CH_4 and N_2O explicitly (the two dominant GHGs from savanna fires) and applying IPCC default factors unless higher-tier country data are available, the methodology ensures conservative estimation and environmental integrity

- **Alignment with leakage standard:** The project boundary is complemented by a leakage belt (see Section 12) to monitor and address activity-shifting LDS fires, in line with the Leakage Standard and the Secretariat feedback that required clarification.

- **Host Party role:** Host Parties may refine the eligible vegetation fuel types or adjust MAR-W thresholds in line with national ecological zones, provided such refinements are consistent with the methodology principles and the PACM Standards. including a regulatory boundary ensures that projects are consistent with the Methodologies Standard (A6.4-STAN-METH-001, paras. 20–24), which requires demonstration of regulatory compliance and clarity on legal eligibility

Table 2 Emissions sources and sinks included in or excluded from the activity boundary

	Source	GHG			Justification / Explanation
BASELINE	Biomass combustion from EDS and LDS fires in eligible savanna Vegetation Fuel Types	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded conservatively. Biogenic CO2 will be recaptured during the subsequent growing (wet) seasons
		CH_4	☒ Included ☐ Not included	☐ Controlled ☒ Related to ☐ Affected by	Primary source of emissions quantified

	Source	GHG			Justification / Explanation
		N_2O	☒ Included ☐ Not included	☐ Controlled ☒ Related to ☐ Affected by	using fire activity data and emission factors
		-----	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded as immaterial
	Fossil fuel combustion from baseline fire management activities	CO_2	☐ Included ☒ Not included	☒ Controlled ☐ Related to ☐ Affected by	Expected immaterial; excluded conservatively.
		CH_4	☐ Included ☒ Not included	☒ Controlled ☐ Related to ☐ Affected by	
		N_2O	☐ Included ☒ Not included	☒ Controlled ☐ Related to ☐ Affected by	
		-----	☐ Included ☒ Not included	☒ Controlled ☐ Related to ☐ Affected by	
	Soil organic carbon (SOC)	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Conservatively excluded
	Harvested wood products	n/a	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	No harvest or timber activity in SFM
ACTIVITY	Biomass combustion from EDS and LDS fires in eligible savanna Vegetation Fuel Types	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded conservatively. Biogenic CO2 will be recaptured during the subsequent growing (wet) seasons
		CH_4	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	Primary source of emissions quantified using fire activity data and emission factors
		N_2O	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	
		-----	☐ Included ☐ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded as immaterial
	Fossil fuel combustion from project operations (vehicles, aerial ignitions)	CO_2	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	Project source; quantified via fuel consumption records. Expected to be de minimis
		CH_4	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	
		N_2O	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	
		-----	☐ Included ☒ Not included	☒ Controlled ☐ Related to ☐ Affected by	

	Source	GHG			Justification / Explanation
	Sequestration in biomass and dead woody debris carbon pools	CO_2	☐ Included ☒Not included	☐ Controlled ☐ Related to ☒ Affected by	Conservatively excluded.
	Soil organic carbon (SOC)	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Conservatively excluded
	Harvested wood products	n/a	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	No harvest or timber activity in SFM
LEAKAGE	Displacement of EDS / LDS fires to leakage belt (activity-shifting)	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded conservatively. Biogenic CO2 will be recaptured during the subsequent growing (wet) seasons
		CH_4	☒ Included ☐ Not included	☐ Controlled ☐ Related to ☒ Affected by	Only material leakage source; quantified in leakage belt monitoring (see Section 12).
		N_2O	☒ Included ☐ Not included	☐ Controlled ☐ Related to ☒ Affected by	
		-----	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Excluded as immaterial
	Positive leakage (spillover of EDS adoption or LDS reduction outside project area as a result of project activities)	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	Documented but not credited per PACM Leakage Standard (positive leakage not credited).
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	
		N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	
		-----	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☒ Affected by	

Explanatory Notes on Table 2:

Treatment of CO_2 from Biomass Combustion:

- Exclusion of biogenic CO_2: In line with PACM rules and IPCC guidelines, CO_2 from the combustion of savanna biomass (both living and dead organic matter) has been excluded from accounting.
- Justification: This CO_2 is considered biogenic and is assumed to be recaptured through regrowth during subsequent wet seasons, meaning there is no long-term net addition to the atmosphere.
- Future refinement: Sequestration and regrowth dynamics of woody savannas are conservatively excluded in this version. However, future iterations of the methodology may consider sequestration of biomass and dead woody debris pools, where robust data and models support credible quantification.

Inclusion of CH_4 and N_2O from Fires

- Both methane (CH_4) and nitrous oxide (N_2O) are consistently included for EDS and LDS fires, as they are the primary non-CO_2 greenhouse gases released in savanna burning.
- These are accounted for using fire activity data and emission factors, consistent with IPCC Tier 2 methods.
- This ensures that the emission reductions achieved by shifting fire regimes are captured conservatively.

Fossil Fuel Emissions

- Baseline fire management fossil fuels (CO_2, CH_4, N_2O) are excluded as immaterial.
- Project fossil fuel use (vehicles, aerial ignitions, MRV operations) includes CO_2 only, while CH_4 and N_2O and may be excluded de minimis at a project level.
- This balances conservativeness with practicality, ensuring project operations are still accounted for without unnecessary complexity.

Soil Organic Carbon (SOC) and Harvested Wood Products

- SOC pools are excluded as there is insufficient evidence that savanna fire management projects materially and consistently alter soil carbon stocks over crediting timescales and for the woody savanna woodlands targeted by this methodology.
- Harvested wood products are excluded, as SFM operations do impact or promote timber harvesting.

Leakage

- Activity-shifting leakage (LDS displacement) into the leakage belt is the only material leakage source and is fully included (CH_4 and N_2O).
  Positive leakage (spillover of EDS burning or reduced LDS fires outside the project boundary) is documented but excluded from crediting, in line with the PACM Leakage Standard**.**

9. Demonstration of additionality

9.1. Regulatory analysis

14. Activity participants shall demonstrate that the mitigation outcome is not required by law and that the activity goes beyond existing legal and regulatory requirements.

Where a mandatory instrument already requires SFM measures (e.g., prescribed EDS burning; restrictions that effectively eliminate LDS burning), the activity is not eligible unless that instrument explicitly refers to or integrates the Article 6.4 mechanism as an implementation pathway. The analysis and its evidence shall be transparent, conservative, credible and reproducible.

(a) **(Scope of instruments to assess) -** The regulatory analysis shall cover, at a minimum, national and sub-national instruments that could directly or indirectly drive the same mitigation outcome as the project, including:

   (i) Laws, regulations, decrees, permitting conditions, protected-area plans, court orders;

   (ii) Recognized customary law and land-use rules applicable within the project boundary;

   (iii) Policies, taxes, subsidies, performance standards, targets with implementation frameworks (not general, unenforceable goals).

(b) **(Procedure for activity participants) -**

(i) *Step 1 — Compile a Legal & Policy Register (LPR).* Identify and list all potentially relevant instruments in force (or adopted and scheduled to enter into force) that apply to the project geography and proponents, covering fire management, environment/biodiversity, forestry, disaster risk, land tenure/rights, indigenous lands, and climate policy.

(ii) *Step 2 — Document instrument attributes*. For each instrument in the LPR, record: legal nature (law/regulation/policy/plan), geographic scope, affected entities, effective date and transition/grace periods, enforcement provisions, sanctions, and whether it explicitly mentions Article 6.4 as an implementation instrument.

(iii) *Step 3 — Direct-requirement screen.* Determine whether any instrument mandates SFM measures that are substantially equivalent to the project (e.g., prescriptive EDS burning, explicit LDS prohibitions, mandatory hazard-reduction burning achieving equivalent ERs). If yes, the activity is not eligible, unless the instrument explicitly allows use of Article 6.4 to implement/credit those measures (document this).

(iv) *Step 4 — Indirect-requirement screen.* Assess whether any instrument indirectly compels outcomes that would achieve the same scale of ERs (e.g., required fire-return intervals; compulsory maintenance of firebreaks that eliminate LDS wildfire spread; biodiversity-management plans mandating seasonality shifts). If yes, treat as a legal requirement for additionality purposes and proceed as in Step 3.

(v) *Step 5 — Policy/target with implementation framework.* If there are policies/targets supported by an implementation framework (e.g., funded, time-bound government programmes) that are reasonably expected to achieve the same ERs without the project, document how the methodology's BAU/baseline procedures already account for these; if they fully internalize the effect, the activity may proceed, but regulatory surplus must still be shown.

(vi) *Step 6 — Tenure/rights verification.* Provide evidence of secure legal right to carry out SFM within the project boundary (titles/leases/recognized customary rights/agreements with custodians), and any required burn permits or protected-area authorizations (if applicable).

(vii) *Step 7 — Decision statement.* Conclude with a Regulatory Surplus Statement listing which of the following applies

  a. "No mandatory instruments apply (direct or indirect)"; or
  b. "A mandatory instrument applies but explicitly integrates Article 6.4 as an implementation mechanism" (attach citation and host Party confirmation); or
  c. "A mandatory instrument applies and the project is ineligible" (do not proceed).

(viii) *Step 8 — Evidence pack.* Attach: copies or official extracts of all instruments; citations and URLs; certified translations if needed; burn permit templates/approvals; tenure documentation; and a Host Party (DNA) attestation confirming that credited outcomes are not simultaneously required by law (and how Article 6.4 use is treated in domestic policy).

(c) **(Frequency of updating)**

(i) At validation: full regulatory analysis and evidence pack.

(ii) At each crediting-period renewal: full update of the LPR and evidence pack.

(iii) Interim trigger updates: if a relevant instrument is adopted, amended, repealed, or newly enforced during a crediting period (e.g., new fire laws, protected-area plans, climate strategies, court rulings), proponents shall reassess before the next verification and update the PDD annexes accordingly. This addresses the explicit gap noted in the AI assessment regarding update frequency and operationalization.

(d) **(Documentation checklist - minimum).** Deliverables to be annexed to the PDD include:
   (i) Inventory of all applicable instruments and their status;
   (ii) Tenure/rights documentation and, where applicable, burn permits/authorizations;
   (iii) Evidence Pack;
   (iv) Host Party Attestation on legal non-requirement and Article 6.4 integration status;
   (v) Regulatory Surplus Statement;
   (vi) Change log capturing updates across the crediting period(s).

15. **Explanatory Notes**

- **Conservativeness principle**: The regulatory analysis must apply a conservative interpretation. Where ambiguity exists — for example, whether a biodiversity law indirectly requires early burning or other fire management practices — the activity participant shall assume the more stringent interpretation (i.e., that the law potentially overlaps with project activities). In such cases, the proponent must provide explicit justification for why the instrument does or does not nullify additionality, supported by citations of the relevant legal text and, where possible, clarification from the host Party's Designated National Authority (DNA).

- **Alignment with PACM Standards:** This requirement ensures compliance with the Additionality Standard (A6.4-STAN-METH-003, Sections 5.1 and 6.1), which obliges activity participants to demonstrate regulatory surplus and update regulatory analysis at least once per crediting period renewal; and the Baseline Standard (A6.4-STAN-METH-004, Appendix 1, Section 2.1), which requires that baseline and additionality assessments reflect the prevailing legal and policy environment in the host country. Taken together, these provisions ensure that activities generate emission reductions beyond what is already required under national or subnational law.

- **Operationalization through host-country–specific datasets:** To make the analysis transparent and verifiable, proponents must compile and submit a Legal & Policy Register that includes: Copies or authoritative citations of fire management legislation, environmental codes, forestry/biodiversity statutes, and land-use regulations; Any relevant subnational or customary law applicable within the project boundary; and Host Party attestations on whether Article 6.4 activities are explicitly recognized or integrated into national instruments.

- **Frequency of updating:** The analysis must be conducted at validation and updated at least once at each renewal of the crediting period, and earlier if material regulatory changes occur (e.g., adoption of new national fire laws, climate strategies, or court rulings). This ensures that eligibility and additionality are maintained throughout the crediting period.

- **Indirect mandates:** The analysis must also account for indirect legal obligations (e.g., land management requirements under biodiversity conservation, forest protection, or indigenous land statutes) that could compel similar emission reductions. Where such obligations exist, proponents must demonstrate that SFM activities under the project achieve mitigation outcomes beyond what would be delivered by compliance with those instruments.

9.2. Avoidance of locking-in the level of emissions

16. Activity participants shall demonstrate that the Article 6.4 activity does not lock in emissions levels or carbon-intensive technologies/practices that are incompatible with the

long-term goals under Article 6.4. This assessment is part of additionality and must be transparent, conservative, and reproducible, in line with the Additionality Standard.

SFM projects generally have a low lock-in risk as they reduce the extent and severity of late dry season (LDS) wildfires by introducing/expanding early dry season (EDS) prescribed burning. This is a practice change, not a capital-intensive technology deployment, and it generally:

- Reduces GHGs (CH_4, N_2O) because LDS fires are more intense and emit more than cooler, patchier EDS burns;
- Reduces wildfire severity/size and builds landscape resilience; extensive empirical work shows prescribed burning lowers subsequent wildfire intensity/severity in seasonally dry ecosystems (including savannas), consistent with fuel-reduction theory and meta-analyses.
- Does not require emissions-intensive infrastructure that could prolong high-emission pathways (no fossil equipment lock-in; operational fuel use is minor and accounted for elsewhere).
- Transfers to other regions (e.g., Miombo, Cerrado) via parameterization frameworks that explicitly aim to reduce LDS impacts rather than entrench them.

Those effects have been assessed in academic literature in Australia over the last >10yrs of operation of those methodologies, with strong evidence such as in this case study: https://www.publish.csiro.au/wf/WF18126 that support the assertion that SFM activities avoid lock-in and instead accelerate a lower-emission fire regime trajectory.

Step-by-step lock-in assessment. In any case, activity participants shall:

(a) Step 1 — Define the assessment boundary and horizon. Describe the activity components (prescribed burns, firebreak maintenance, training, monitoring) and any durable assets. Specify the assessment horizon (≥ the crediting period).

(b) *Step 2 — Screen for potential lock-in "vectors".* Evaluate the following vectors and document whether the project would prolong or institutionalize any emissions-intensive pathway:
  - Technology/infrastructure lock-in: Does the activity require long-lived, emissions-intensive equipment or installations? (e.g., diesel-dependent fixed plant). Expected for SFM: No.
  - Land-use/land-cover lock-in: Does the activity promote a land-use state that raises future emissions or forecloses mitigation options (e.g., conversion or clearing)? SFM excludes clearing by applicability.
  - Behavioral/institutional lock-in: Would the activity embed practices that *increase* LDS wildfire risk or dependence on high-emission responses? SFM does the opposite (shifts to EDS).
  - Financial lock-in: Would sunk costs or contracts commit proponents to high-emission operations beyond the crediting period?

(c) *Step 3 — Evidence package.* Provide documented evidence showing the vectors above are not triggered, including:
  - Activity design (showing EDS burns and mosaic objectives).
  - Burn protocols and training materials demonstrating avoidance of LDS intensification.
  - Inventory of durable assets (type, expected life, fuel use) and confirmation that no long-lived, emissions-intensive infrastructure is created.
  - Cross-reference to applicability exclusions (no clearing; woody savannas only).
  - Literature citations supporting LDS risk reduction (see §9.2.2). CSIRO Publishing+1

(d) *Step 4 — Optional crediting-period sufficiency test.* Where the total crediting period ≤ 10 years, proponents may argue lock-in risk is absent or minimal under the Additionality Standard's framing of lock-in (short horizons reduce the possibility of structural entrenchment). Provide the crediting-period schedule and show assets do not outlive the period in ways that would force continued emissions.

(e) *Step 5 — Decision statement.* Conclude with a Lock-in Risk Statement:
- "No lock-in vectors are triggered"; or
- "A potential vector was identified, but mitigations eliminate the risk"; or
- "Lock-in cannot be ruled out" and the project is ineligible unless modified.

(f) Deliverables (PDD annexes): LIR-1 Vector Screen; LIR-2 Asset Inventory; LIR-3 Burn Protocols; LIR-4 Literature Evidence; LIR-5 Decision Statement.

Neutral assessment protocol (DOE-verifiable) To ensure consistency and neutrality across projects, apply the following pass/fail protocol. All four vectors must Pass (or be mitigated to Pass). Any Fail means that the activity is not eligible unless design changes remove the lock-in:

(a) Technology/infrastructure:
  (i) Pass if no long-lived emissions-intensive assets are installed; if installed, show (i) emissions are de minimis, (ii) lifetime ≤ crediting period, or (iii) a retirement/transition plan.
  (ii) Fail if the project installs assets that would require continued fossil use beyond the crediting period without a transition plan.

(b) Land-use/land-cover
  (i) Pass if the activity does not induce conversion/clearing and keeps options open for future mitigation/removals; show alignment with applicability exclusions.
  (ii) Fail if it induces conversion or forecloses mitigation pathways.

(c) Behavioural/institutional
  (i) Pass if operating procedures shift to EDS and demonstrably reduce LDS severity/extent (cite monitoring indicators and literature).
  (ii) Fail if procedures could increase LDS wildfire risk or create reliance on high-emission responses.

(d) Financial
  (i) Pass if sunk costs/contracts do not compel emissions-intensive operations beyond the crediting period (or if contracts have green-exit clauses).
  (ii) Fail if financial structures would compel continued emissions.

17. **Explanatory Notes**
- **Standards alignment.** The lock-in test gives practical effect to the Article 6.4 methodology principles that activities be real, transparent, conservative and credible, and that claims rest on clear, verifiable evidence. It also supports the requirement that activities align with the host Party's NDC and LT-LEDS so they do not entrench emissions-intensive pathways.
- **Why SFM has low lock-in risk**. Savanna Fire Management is a shift in land-management practice—using EDS burning to reduce LDS wildfire extent and intensity—rather than an investment in long-lived, fossil-dependent infrastructure. Because the credited outcome is an annual flow of avoided CH_4 and N_2O emissions, and sequestration stocks are excluded, the activity does not structurally bind future emissions levels.
- **Neutral protocol in practice.** The methodology's vector screen (technology/infrastructure, land-use/land-cover, behavioral/institutional, and financial) provides a neutral pass/fail basis for demonstrating no lock-in. Projects must either pass each vector outright or document design mitigations that convert potential risks into a pass, ensuring a reproducible DOE validation.
- **MRV signals that corroborate "no lock-in."** Over time, monitoring should show a stable or declining LDS share of burned area, sustained mosaic patchiness, and years-since-last-burn distributions consistent with reduced LDS severity. These

indicators reinforce that the project is not institutionalizing higher-emission fire regimes while remaining aligned with host-Party transition pathways.

- **Periodic reconfirmation**. The “no lock-in” conclusion should be reconfirmed at each crediting-period renewal and whenever material policy or land-use changes occur, maintaining continuous consistency with the host Party’s policies, options and implementation plans under its NDC and LT-LEDS..

9.3. Investment analysis, Barrier analysis and Common practice analysis

9.3.1. Investment analysis

18. **Investment analysis is the default route** to demonstrate financial additionality for SFM. Activity participants shall apply the procedure below, consistent with the Additionality Standard §6.3 (types of analyses; detailed procedure; general requirements). The methodology specifies the permitted analysis types and the decision rules for when each must be used and sets a detailed procedure for conducting. This ensures transparency and comparability across projects. Project participants shall apply the following decision framework:

(a) **(Simple Cost Analysis) -** Applied where the SFM activity does not generate any non-carbon revenues or cost savings to the project entity. This tests that implementation entails costs without offsetting non-carbon benefits. In this case:
   (i) Build an annual real (or nominal) after-tax cash-flow of all CAPEX/OPEX over the assessment period.
   (ii) Confirm and document the absence of any non-carbon revenues/savings (budgets, audited accounts, signed declarations).
   (iii) The activity is financially additional if costs are strictly positive and there are no non-carbon revenues/savings.
   (iv) (Optional transparency) Report levelized abatement cost (total discounted cost / discounted tCO_2e reduced)

(b) **(Benchmark Analysis) -** Applied where any non-carbon revenues or monetized cost savings exist. Compare the project’s financial indicator to a conservative financial benchmark (e.g., WACC). In this case:
   (i) Choose indicator(s): NPV (primary) and/or IRR.
   (ii) Derive a conservative benchmark (WACC) from multiple sources (take the lower estimate).
   (iii) Compute NPV at benchmark WACC and IRR for the project without A6.4ERs (and excluding A6.4 transaction costs).
   (iv) If NPV < 0 at the benchmark WACC or IRR < benchmark, the project is not financially attractive without A6.4ERs, and passes investment additionality. Otherwise, it fails, unless the Investment Comparison Analysis (below) shows the project is less attractive than a credible alternative.

(c) **(Investment Comparison Analysis)** Applied where on-carbon revenues/savings exist and there is a credible alternative (e.g., status quo wildfire response). Compare the project’s financial attractiveness (without A6.4ERs) to the alternative(s) under a common basis. In this case:
   (i) Define at least one credible alternative (e.g., status-quo or conventional suppression) and build its cash-flow on the same basis (real vs. nominal; taxes; period).
   (ii) Discount all options at the same benchmark (WACC).
   (iii) The activity is additional if the project’s NPV is lower (or IRR is lower) than the alternative(s) without A6.4ERs as it indicates the project would not be chosen absent A6.4ER revenues

Parameterization and evidence requirements. Activity participants shall compile a Cash-Flow Workbook and an Evidence Pack containing at minimum:

(d) **CAPEX & OPEX:** All relevant costs (planning/approvals, training, ignition operations, vehicles, aerial support, MRV, leakage-belt monitoring, community engagement, insurance, contingencies). Include any monetized barriers as additional costs where applicable.

(e) **Revenues/cost savings**: All non-carbon revenues or savings (e.g., service contracts, subsidies, avoided fire-damage costs if monetized).

(f) **Benchmark (WACC)** evidence for Benchmark Analysis: At least two independent sources for host-country (and, if available, sector) WACC or equivalent benchmarks; derive a conservative benchmark (use the lower of entity-specific vs. market benchmark if both exist.

(g) **Alternative(s) specification** for Investment Comparison: Define the most credible alternative and its cash flows on a consistent basis (same price base, tax/inflation treatment, timing).

(h) **Decision-date consistency:** Data and assumptions must be consistent with what the entity's management/investors had at the start date; if the PDD is submitted before the start date, update the analysis at first verification with data that were available at the start date.

(i) **Public-funding test:** If public funding (grant equivalent) exceeds expected A6.4ER revenues, demonstrate that such funding would not have filled the gap in the absence of A6.4ERs.

(j) **Country-specific datasets at validation:** Provide (i) WACC/benchmark sources; (ii) sector-level comparators; (iii) detailed CAPEX/OPEX datasets for SFM cost categories.

Financial indicator, assessment period, and cash-flow basis.

(k) **Indicator(s):** NPV at the benchmark discount rate (primary), and/or project IRR (supporting), as acceptable financial indicators under the Standard.

(l) **Assessment period:** Reflect the expected operation of the SFM practice and include any residual value of assets at period end (vehicles, equipment). For SFM, the assessment period is typically 10–15 years with residual values where applicable.

(m) **Cash-flow basis (internal consistency):** Use either (i) real, after-tax cash flows discounted with a real, after-tax benchmark rate, or (ii) nominal, after-tax cash flows with a nominal, after-tax rate. You must state which basis is used and apply it consistently to all parameters (prices, escalation, depreciation).

(n) **Without-A6.4ERs test & exclusion of transaction costs:** The financial viability test is performed without A6.4ER revenues, and must exclude any A6.4 transaction costs (PDD preparation, validation/verification, UNFCCC fees, registry, issuance) when analyzing the case "without A6.4ERs"

Sensitivity analysis. Activity participants shall perform a one-way sensitivity on critical parameters to test robustness to reasonable variations and provide table of results. At minimum, the analysis should consider: CAPEX: ±20%; OPEX: ±20%; Non-carbon revenues/savings: −20% / +0%; Benchmark discount rate (WACC): ±200 basis points; Residual value: −50% / +0%. If results are borderline, provide a two-way sensitivity on the dominant pair(s) (e.g., discount rate vs. OPEX). Document rationale where country/sector conditions warrant wider ranges.

Timing of analysis and updates. Activity participants shall provide the full analysis and evidence, and documentation above at Validation, and update the analysis at first verification using data available at the start date. On crediting period renewal, Activity participants shall assess whether material changes have occurred in cost structure, market benchmarks, or public-funding conditions, before undertaking the full analysis again if change shave occurred.

19. **Explanatory Notes**

- The investment analysis must be prepared strictly from the activity participant's perspective and use data that are consistent with what the entity's decision-making management and investors/lenders had at the start date of the activity; broader economy-wide effects are out of scope under this test.
- The analysis must include all relevant costs (CAPEX and OPEX), any monetizable barriers quantified as additional costs, and all revenues and cost savings, including public funding where applicable; all parameters and assumptions must be internally consistent, and the assumptions, data and conclusions must be transparently documented and substantiated by evidence.
- The analysis must be implemented conservatively and include a sensitivity analysis demonstrating that the conclusion is robust to reasonable variations in critical parameters such as CAPEX, OPEX, revenues and cost savings.
- Transaction costs associated with generating A6.4ERs (for example, PDD preparation, validation and verification, UNFCCC fees) must be excluded from the "without A6.4ERs" case when testing financial viability.
- This section operationalizes paragraph 36 by specifying which analysis types are used and by setting a detailed, replicable procedure; it also adds default sensitivity ranges and reporting tables and codifies both the public-funding test and timing updates.

9.3.2. Barrier analysis

20. Barrier analysis may only be applied under the narrow circumstances permitted by *Additionality Standard paras. 34–37*. Specifically:

(a) Where the project is implemented by households, community-based organizations, or small public/private entities with demonstrably limited access to finance; or

(b) Where methodology proponents or host Parties demonstrate the presence of sector-wide, non-financial barriers at the methodology or standardized baseline level.

Eligible barriers may include:

- Institutional barriers, such as restrictive or outdated fire-management regulations that hinder adoption of EDS burning.
- Information barriers, such as lack of technical knowledge, training, or fire-science capacity in local implementing entities.
- First-of-its-kind barriers, where an SFM project is pioneering in a country or region and faces uncertainty or reluctance due to lack of precedent.
- Financial barriers are not eligible under this test; all financial viability issues must be assessed under Investment Analysis (Section 9.3.1).

For SFM, which typically involves large-scale projects managed by NGOs, governments, private landholders, project developers or consortia with access to private, public or philanthropic finance, barrier analysis will not normally apply. Where used, activity participants must apply the PACM five-test procedure to demonstrate robustness:

- Barrier identification – Clearly describe the barrier(s).
- Causality – Show how the barrier prevents implementation of SFM activities.
- Substitution – Demonstrate that no equivalent project type exists that circumvents the barrier under similar conditions.
- Decisiveness – Prove that the barrier is critical to the project's non-implementation.
- Alternative test – Confirm that the most plausible alternative does not face the same barrier.

21. **Explanatory Notes**

- Alignment with Additionality Standard: By limiting use to small-scale entities or systemic sectoral barriers, this section aligns with paras. 34–37 of A6.4-STAN-METH-003, which treat barrier analysis as a supplemental and narrow tool, not a substitute for investment testing.
- Application in practice: For most SFM projects, Investment Analysis (Section 9.3.1) and Common Practice Analysis (Section 9.3.3) will be the primary additionality tests. Barrier Analysis provides a fallback route only where there are proven, non-financial, and decisive constraints.
- Activity participants will need to provide documented evidence of institutional, information, or first-of-its-kind barriers (e.g., legal codes, training capacity assessments, historical precedents) at validation to support this claim.

9.3.3. Common practice analysis

22. A Common Practice (CP) Analysis is mandatory whenever additionality is demonstrated through Investment Analysis (Section 9.3.1) or Barrier Analysis (Section 9.3.2). The objective is to demonstrate that the proposed activity type is not already common practice in comparable circumstances within a defined geographic/sectoral boundary. The procedure below specifies the boundary, comparator, thresholds, data hierarchy, uncertainty treatment, decision rule, and validation evidence, ensuring a transparent and reproducible assessment consistent with the Additionality Standard’s CP requirements.

Activity participants shall conduct the CP Analysis at validation and reconfirm at each crediting-period renewal, or earlier if a material expansion of government prescribed-burn programs or comparable private initiatives occurs within the boundary.

Activity participants shall conduct the CP Analysis through the following steps:

(a) **Define the geographic boundary**:

(i) Primary option (national savanna zone): the woody-savanna ecological zone within the host country, excluding clearly non-comparable subregions (e.g., non-woody biomes).

(ii) Alternative option (subnational unit): a subnational woody-savanna region with homogeneous ecology (rainfall bands, vegetation fuel types) and policy settings (fire legislation/programs). Use this option when national heterogeneity would bias prevalence upward or downward.

The boundary must be justified with reference to vegetation type, prevailing fire regime (EDS/LDS seasonality), and the socio-political context (presence/absence of prescribed-burn programs). Proponents shall provide a boundary map and narrative justification.

Stratification: Where heterogeneity remains material, stratify by rainfall class (e.g., 400–1000–2200 mm), vegetation fuel type, or administrative region, conduct the CP test per stratum, then aggregate conservatively (see (d) and (f)(iv)). .

(b) **Define the comparator and indicator(s) of prevalence.** Define the comparator as systematic Early Dry Season (EDS) fire management in woody savannas, meaning a documented, planned program (public or private) that results in a sustained, material shift from LDS to EDS burning at landscape scale.

(i) Comparator: Systematic Early Dry Season (EDS) fire management in woody savannas, meaning a documented, planned program (public or private) that results in a sustained, material shift from LDS to EDS burning at landscape scale.

(ii) Primary indicator: The percentage of eligible savanna area within the boundary that practices systematic EDS management. Operationalize this as areas meeting both of the following over a defined window of five most recent years (or the HRP, if longer):

a. EDS dominance: EDS share of burned area (EDS/(EDS+LDS)) ≥ 60% in ≥ 3 of 5 years; and
b. Program evidence: coverage by a documented prescribed-burn program (government or equivalent) or a recurring, planned private/communal program.

(iii) Secondary indicators (corroboration only): (i) number and coverage of formal prescribed-burn programs; (ii) YSLB and patchiness statistics consistent with mosaic EDS regimes; (iii) long-term decline in LDS fraction attributable to planned EDS rather than exogenous shocks.

(c) **Quantify prevalence using a defined data hierarchy.** Use the highest available tier; if unavailable, step down and justify. Document methods, classification thresholds for EDS/LDS, QA/QC procedures, and time windows used.

(i) Tier 1 (authoritative national): Host-country fire management datasets and annual reports that document program coverage and operational status; national burned-area/seasonality products with QA/QC.

(ii) Tier 2 (global EO with QA/QC): MODIS MCD64A1 burned area (seasonal compositing), VIIRS hotspots (temporal tagging), and Sentinel-2/Landsat fire-scar maps to compute EDS vs. LDS fractions using the methodology's season definitions and ≥80% mapping accuracy.

(iii) Tier 3 (other documented sources): Regional studies, NGO program records, and expert-validated inventories.

(d) **Apply conservative uncertainty treatment and aggregation.** Compute prevalence with confidence bounds (e.g., 90% CI) reflecting mapping/classification uncertainty. For the purpose of disallowing non-additional projects, apply a conservative (high) estimate of prevalence: if the upper bound of the CI meets or exceeds the threshold, treat the practice as common. When aggregating strata, weight by eligible area and, where data are missing for a stratum, assume a higher prevalence unless robust evidence shows otherwise.

(e) **Common Practice Thresholds.** The SFM practice is deemed common if ≥ 50% of eligible savanna area within the boundary meets the systematic EDS definition in (b).

(i) If the point estimate or the upper CI of prevalence is ≥ 50%, classify the practice as common and the project fails the CP test.

(ii) If the upper CI is < 50%, the project passes the CP test (subject to (iii) below).

(iii) **Host Party Endorsement:** Where the Host Party defines or endorses a different sector-specific threshold for SFM (with justification and public documentation), apply that threshold; if not provided, use the default. Proponents must state which threshold applies and keep it constant across the crediting period.

(f) **Validation evidence and deliverables requirements:** Activity participants must document which threshold applies at validation and apply it consistently throughout the crediting period. Submit the following with the PDD (and update at renewal if conditions change):

(i) **Boundary dossier:** boundary map, ecological/policy rationale, and any strata used.

(ii) **Methods dossier:** EDS/LDS definitions, EO processing workflow, QA/QC results, and the five-year window (or HRP, if longer).

(iii) **Data pack:** shapefiles/rasters (burned area; EDS/LDS layers), program coverage maps/reports, and a table listing all data sources with access links or appendices.

(iv) **Results table:** prevalence by stratum and aggregated; confidence intervals; and sensitivity checks (e.g., varying the EDS dominance threshold from 55% to 65%).

(v) **Threshold statement:** the threshold applied (Host Party-endorsed or default), the conservative test used (upper-CI rule), and the decision (pass/fail) with rationale.

23. **Explanatory Notes**

- The CP test confirms that the SFM activity type is not already widely adopted under comparable circumstances and is mandatory whenever additionality is shown via investment or barrier analysis.
- The geographic/sectoral boundary must reflect comparable ecological and policy conditions; where heterogeneity is material, proponents shall stratify (e.g., by rainfall band or vegetation fuel type), justify the approach, and provide a boundary map.
- The comparator is systematic Early Dry Season fire management at landscape scale; prevalence is counted only where EDS dominance is demonstrated and a documented prescribed-burn program is in place, avoiding incidental or weather-driven EDS signals.
- Proponents shall follow a data hierarchy that prioritizes authoritative national sources and validated Earth-observation products, document methods and season definitions, and apply QA/QC with stated accuracy.
- Prevalence estimates must include confidence bounds; the upper confidence limit is tested against the threshold, and strata are aggregated conservatively with appropriate weighting and assumptions for missing data.
- The default threshold is 50 percent of eligible area under systematic EDS; a Host Party may endorse a different SFM-specific threshold if publicly justified, and the selected threshold must remain constant over the crediting period.
- Validation requires a standard evidence pack: boundary and methods dossiers, EO rasters and program coverage records, prevalence results with confidence intervals and sensitivity checks, and a threshold statement, with DOE cross-checks.
- The CP analysis must be performed at validation and reconfirmed at each crediting-period renewal, or earlier if material expansion of prescribed-burn programs or comparable initiatives occurs.

9.4. Performance-based approach

24. n/a

25. In accordance with paragraph 31 of the Additionality Standard, performance-based additionality may only be applied where (a) project activities result in homogeneous products or services that are directly comparable across a defined market, and (b) the baseline is determined using the Best Available Technology (BAT) or Ambitious Benchmark approaches under paragraph 36(i)–(ii) of the RMP.

This methodology applies the Historical Emissions Approach [36(iii)] and addresses land-based ecosystem dynamics that are heterogeneous and spatially variable. Savanna fire management (SFM) projects involve landscape-scale shifts in fire timing, frequency, and intensity, which do not lend themselves to uniform product/service outputs or standard performance benchmarks.

For these reasons, the methodology explicitly excludes the use of performance-based additionality. Instead, additionality is demonstrated through: Investment analysis (default approach), per Section 9.3.1; Barrier analysis (limited applicability, small entities only), per

Section 9.3.2; and Common practice analysis (mandatory when other approaches are applied), per Section 9.3.3.

To avoid confusion or methodological ambiguity, no references to performance benchmarks or performance-based pathways are retained in this methodology , and this section can be removed.

10. Baseline scenario

10.1. Selection of the baseline approaches from paragraph 36 of the rules, modalities and procedures

26. The methodology applies paragraph 36(iii) of the RMPs: an approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 of the RMP. This choice is justified on the following grounds:

(a) **Applicability to SFM (Baseline Standard, para. 56–57):**
- Emissions from savanna fires are highly site-specific and vary according to rainfall, vegetation structure, ignition sources, and cultural fire practices.
- Sectoral data shows strong heterogeneity across regions, meaning that technology or benchmark approaches (paras. 36(i) and 36(ii)) are not appropriate.
- There is limited data availability on performance of comparable fire-management activities in many potential host countries, further reinforcing the need for a historical approach.

(b) **Exclusion of alternatives:**
- Best Available Technology (BAT): Not applicable because SFM is not a technology-driven mitigation option. Prescribed burning is a management practice, not a deployable “technology” with globally comparable benchmarks.
- Ambitious Benchmark: Not suitable, as there is no global benchmark dataset of “best performing” SFM activities across savannas. Fire regimes are driven by ecological and climatic heterogeneity rather than technological efficiency.

(c) **Alignment with ecological and methodological precedent:**
- Historical fire emissions approaches are well-established in savanna fire methodologies (e.g., Australia’s ACCU savanna burning methods).
- A long-term Historical Reference Period (HRP) (7 years or longer where data is available) captures inter-annual variability in rainfall and fuel accumulation cycles, thereby producing a stable and representative baseline.
- This approach ensures the baseline reflects the natural fire regime that would occur without project intervention, while avoiding distortions from anomalous single-year events (e.g., exceptionally wet or dry years).

(d) **Scientific and policy justification.** The Historical Emissions approach:
- Captures natural variability: Woody savannas are subject to high inter-annual climate variation. A multi-year HRP smooths anomalies, providing a statistically robust foundation.
- Reflects ecological cycles: Lower rainfall regions exhibit longer fire-return intervals; therefore, longer Historical Reference Periods are required to account for coarse-fuel accumulation and equilibrium conditions.
- Aligns with PACM conservativeness requirements: By mandating downward adjustments and BAU screening in later steps (paras. 59–77 of the Baseline Standard), this approach guarantees that baselines will be progressively conservative and aligned with host-country ambition.

- ☐ Best available technologies that represent an economically feasible and environmentally sound course of action, where appropriate.
- ☐ An ambitious benchmark approach where the baseline is set at least at the average emission level of the best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances.
- ☒ An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 of the RMP.

27. **Explanatory Notes –** Justification of Historical Emissions Approach

The adoption of the historical emissions approach under paragraph 36(iii) of the RMP is a deliberate and scientifically justified choice that ensures environmental integrity and methodological robustness. The use of a Historical Reference Period (HRP) provides a stable and representative demonstration of fire regimes in woody savanna ecosystems, ensuring that credited emission reductions are truly additional and not the result of short-term variability.

(a) Capturing Natural Inter-annual Variability

- Woody savannas are highly fire-prone ecosystems where fire regimes are influenced by rainfall variability, fuel accumulation, ignition sources, and land-use pressures.
- A short baseline period (e.g., 1–2 years) would be insufficient, as it could over-represent anomalously wet or dry conditions, leading to inflated or understated baseline emissions.
- A longer HRP (10–15 years, or more where data is available, and no less than 7years in any case) smooths out annual anomalies and ensures a statistically robust baseline. This aligns with Baseline Standard para. 61(a), which requires consideration of the minimum number of historical years and inter-annual variability.

(b) Addressing Ecological Dynamics

- The HRP is tailored to the distinct ecological characteristics of eligible woody savannas. In lower rainfall zones, fires are less frequent, and coarse fuel accumulation cycles are slower; therefore, longer HRPs are needed to reflect the true fire regime.
- In higher rainfall zones, where fires are more frequent, shorter HRPs may suffice, but the 10–15 year minimum ensures ecological cycles are adequately represented.
- This design choice ensures compliance with Baseline Standard para. 57(a)–(b), which recognize site-specific and heterogeneous sectoral conditions.

(c) Scientific and Methodological Precedent

- The use of long-term historical baselines is consistent with the Australian Savanna Fire Management methodologies under the Emissions Reduction Fund (ERF/ACCU scheme), which have established scientific credibility and operational precedent.
- This precedent demonstrates that longer HRPs reliably capture both fire dynamics and the impacts of climate variability, providing a defensible baseline foundation.

(d) Ensuring Additionality and Conservativeness

- The HRP ensures that emission reductions represent a genuine shift in land management practices (i.e., transition from LDS wildfires to EDS prescribed burns), not temporary climatic anomalies.

- The approach also facilitates downward adjustment (Baseline Standard paras. 59–60, 64–66), which further strengthens conservativeness and ensures alignment with host-country ambition.

(e) Remaining Requirements

- Proponents will need to provide evidence of HRP data quality (e.g., remote sensing fire scars, emissions factors, and rainfall records) and demonstrate statistical robustness at the validation stage.
- Where national or regional fire datasets are incomplete, conservative defaults or proxy data (e.g., control groups, model outputs, or IPCC Tier 1 factors) must be transparently documented, in line with Baseline Standard para. 61(b)–(d).

10.2. Application of the selected approach, prior to implementation of a downward adjustment

10.2.1. Procedure for the identification of the baseline scenario

28. In line with section 6.3.2 of the Baseline Standard, the baseline scenario for Savanna Fire Management (SFM) is identified based on existing actual or historical emissions from fire activity within the defined project area, as the continuation of historical fire regimes within the project area. This reflects the persistence of late dry season (LDS)-dominated burning in the absence of project intervention, which is the most plausible counterfactual scenario. The baseline is therefore site-specific, reflecting observed fire regimes over the Historical Reference Period (HRP) and providing the most credible representation of what would occur in the absence of the Article 6.4 activity.

Consistent with paragraph 60 of the Baseline Standard, the following options were considered:

(a) (Continuation of the pre-activity scenario) - Selected as the default for SFM projects. Historical fire emissions, derived from the Historical Reference Period (HRP), represent the counterfactual fire regime.

(b) (Dynamic baseline scenario) – May apply only if evidence of long-term downward trends or policy-driven changes exists (e.g., introduction of mandated prescribed burning). These are screened under Section 10.4.

(c) (Retrofit or replacement of equipment) – Not applicable; SFM is not equipment-driven.

(d) (Delayed implementation of the Article 6.4 activity) – Not applicable; fire management is an ongoing land-use practice, not a deferred technology adoption.

The methodology defines baseline emissions in tonnes of CO_2-equivalent (tCO_2e) using the following Site-specific historical data:

(a) The HRP must include at least 7 years of consistent fire activity data, extending to a maximum of 20 years or 2–4 times the mean fire return interval (FRI).

(b) The dataset must capture inter-annual variability in burned area, fuel load, fire seasonality, patchiness, and years since last burn (YSLB).

(c) Trends in historical data (e.g., decreasing fire frequency due to informal community practices) must be statistically tested. If trends are material, they are incorporated via a conservative downward adjustment (see Section 10.4).

(d) Where structural changes in national policies exist, these must also be incorporated in the baseline scenario screening.

Procedural requirements for activity participants. Activity participants shall:

(e) Define the baseline as the continuation of LDS-dominated fire regimes, quantified using HRP data stratified by vegetation fuel type and fire season; and demonstrate that the HRP is representative, in line with Section 10.2.2, by covering a sufficient number of years to capture inter-annual variability.

(f) Document and justify all assumptions (e.g., HRP datasets, fire season boundaries, fuel load accumulation models, including burned area, month of burn, and vegetation type, and patchiness) consistent with monitoring procedures.

(g) Confirm that no alternative baseline scenarios from options (b)–(d) of section 6.3.3 of the baseline standard are more plausible for the project area.

(h) Apply the step-wise approach for determining the crediting baseline as described in section 5.1 of the baseline standard, in line with the requirements of the following sections below.

29. Explanatory Notes:

- The chosen baseline scenario (continuation of pre-activity LDS regimes) ensures compliance with para. 59 of the Baseline Standard by grounding the baseline in actual historical data.
- Explicit consideration of the other three options under para. 60 ensures transparency and demonstrates why they are not applicable to SFM.
- This procedure ensures that baseline identification remains consistent, conservative, and replicable across different project areas.
- The HRP is determined using the fire frequency statistics derived from the same variables and structure as project monitoring (burned area × fuel load × combustion efficiency × emission factors, stratified by vegetation fuel type and season).

10.2.2. Calculation of baseline emissions prior to downward adjustment

30. Baseline emissions are quantified from site-specific historical fire activity, consistent with the *“existing actual or historical emissions”* approach (RMP para. 36(iii), Baseline Standard 6.3.3). The primary gases considered are methane (CH_4) and nitrous oxide (N_2O), which are the most material emissions from biomass in the eligible Vegetation Fuel Type pools burning in woody savannas. Biogenic CO_2 is excluded (see SSR table justification), as it is reabsorbed through regrowth in subsequent wet seasons.

The method for quantifying emissions reductions is based on direct observation of the spatial extent (e.g. through remote sensing of burnt areas) and date of fires (as a proxy for fire severity).

These observations are then coupled with measures of emission factors described in peer reviewed literature from fires occurring within a specified applicable regional envelope (seasonal woody savanna vegetation landscapes such as the Northern Australian savannas, South African Miombo or Brazilian Cerrado, or other ecosystems as listed in Figure 4) occurring within a specified mean annual rainfall isohyet (usually 400mm to 2,200mm).

To account for seasonality and thus enable the quantification of emission reductions resulting from a change in the seasonality and extent of fire, emission factors are stratified by fire season (Early Dry Season or Late Dry Season), time since last burned, and vegetation fuel types and other ancillary parameters:

(a) **(Minimum number of historical years)** - The baseline scenario is identified by first quantifying site specific historical fire emissions over a Historical Reference Period (HRP) that captures inter-annual variability, avoids bias from outlier years, and is consistent with ecological fire-return intervals.

To establish the baseline, there must be records of historical fire activity (including extent and month of burnt areas) available during the Historical reference period. The crediting baseline is then defined by reference to the business-as-usual Fire Regime represented by the fire history during the Historical Reference Period for the project area (including proportions of eligible Vegetation Fuel types burnt in the Early Dry Season and in the Late Dry Season)

The Historical Reference Period (HRP) must include at least seven (7) consecutive years immediately before the project start date. Where data availability allows, the HRP should extend to cover at least two mean fire return intervals (FRIs) of the dominant vegetation types, up to a maximum of 20 years or four FRIs, whichever is smaller. This ensures a statistically robust sample that smooths anomalies from unusually wet or dry years.

(b) **(Treatment of year-on-year variability) -** Inter-annual variability in fire activity, driven by rainfall anomalies (e.g., ENSO events) or human activity, is explicitly accounted for by calculating the multi-year mean emissions over the HRP. All years within the HRP are included, even extreme years, to avoid bias. Their influence is moderated by the length of the HRP. Proponents must document statistical measures (e.g., mean, standard deviation, coefficient of variation) to demonstrate that the HRP average is representative.

(c) **(Trends in historical data) -** If long-term trends are observed (e.g., decreasing LDS area burned due to government policy, or increasing fire severity due to climate change), they must be quantified. Where trends are material (≥5% change in baseline emissions over the HRP), the baseline must be dynamic (declining baseline applied forward) or adjusted by applying conservative adjustment factors. This ensures the baseline does not overestimate emissions reductions relative to a plausible BAU scenario.

(d) **(Adjustments for improvements in performance) -** The methodology requires that any structural changes, policy interventions, or sector-wide fire management improvements already in effect during the HRP are incorporated into the baseline. Where sectoral benchmarks or host country fire-management policies imply future improvements in baseline performance, the baseline must be adjusted downward accordingly. This ensures the baseline reflects a conservative estimate of BAU and avoids crediting reductions that would occur in the absence of the project.

(e) **(Data sources and Use of Digital Monitoring Reporting and Verification system, or dMRV) -** Burned area (BA) and fire season (EDS/LDS) are derived from remote sensing products (MODIS, Sentinel-2, Landsat) at ≥250m resolution. Fuel loads are stratified by Years Since Last Burn (YSLB), vegetation fuel type, and fuel size class. Patchiness and combustion efficiency are derived from peer-reviewed regional literature or field studies. A digital monitoring, reporting and verification (dMRV) system that is approved by PACM may be used to calculate all steps described in this section, and to monitor changes in the parameters.

(f) **(Quantitative guidance on establishing the Historical Reference Period):**

(i) (EDS/LDS Dates) Proponents must determine the relevant Dry Season and key dates applicable for the project area as described below. The Dry Season is defined as the entire period between the Start of EDS and the End of LDS. Proponents must determine the dates below based on regionally specific remotely sensed or in-field measurements, whichever is more appropriate, and data from reputable climatology sources (e.g. long-term rainfall). Relevant datasets and sources must be referenced in the Project Description Document.

(ii) (End of the Historical Reference Period) The End of the Historical Reference Period shall be the day before the Project Start date and is:

- For project activities in the southern hemisphere: the 31st of December of the calendar year immediately prior to the Project start date.
- For proponents who wish to determine and use a different date, and for project activities in the northern hemisphere: The date that represents the mid-point of the wet season is determined based on historical rainfall records.

(iii) (Start of EDS - also the start of Dry Season). The Early Dry Season Start Date immediately follows the end of the wet season. It must be set as the day immediately before the first 4-week period for the year with no significant rainfall when compared with the preceding 4-week period.

(iv) (End of LDS - also the end of Dry Season). The Late Dry Season End Date must be set as the beginning of the period that represents the start of the rainy/wet season in the region. This is represented either by a regionally accepted convention, or the beginning of the wettest 8-week period of the year.

In determining the LDS End Date, proponents must ensure that the Dry Season (Russell-Smith *et al*. 2021, adapted for global applications) lasts at least 4 to 5 months, and covers a period where cumulative rainfall is <10% of MAR-W.

(v) (Cut Off Date for End of EDS and Start of LDS). Once the Dry Season period is determined, the Cut Off Date that marks both the End of EDS and Start of LDS and is determined by calculating the total number of days in the Dry Season period and splitting it in half to determine the respective EDS and LDS periods.

(vi) (Vegetation Fuel Type Map). At the start of each Crediting Period, the activity participants must create a Vegetation Fuel Type map in accordance with the methodology and ensure that the Vegetation Fuel Type map remains accurate at each verification event.

(vii) (Selecting the Historical Reference Period). To establish the Baseline Scenario, the Project must set (see Figure 6):

a. The Historical Reference Period must include the largest possible number of years (YHRP) immediately prior to the Start of the Project Date. To ensure that it is representative, the Historical Reference Period (Y_{HRP}) must include a minimum of 7 years, and cover a period of at least 2 times the Mean Fire Return Interval (FRI) for the Project Area, to a maximum of 4 times FRI, or 20 years (whichever is smallest). Such calculations must be based on consistent fire activity datasets, at 250m pixel scale or finer resolution, and include data allows the calculation of the Years Since Last Burnt (YLSB).

b. The Historical Reference Period Start Date is the date that is start of the year that is Y_{HRP} years before the Project start date.

c. The Historical Reference Period End Date is the day before the Project start date.

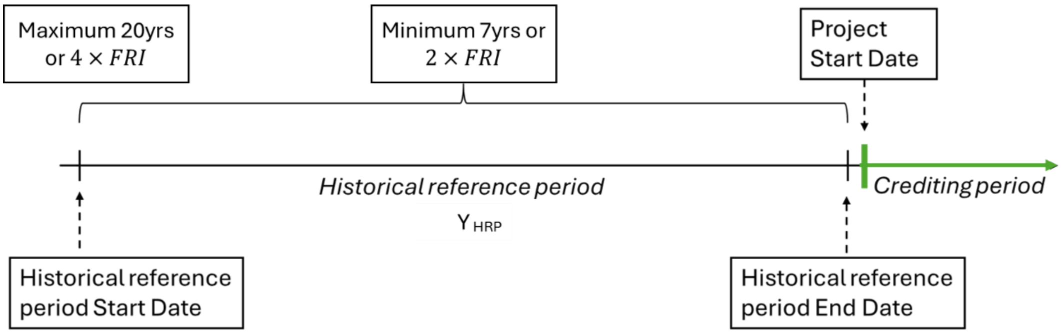

Figure 6 Key Historical Reference Period for SFM projects

The Mean Fire Return Interval for each vegetation fuel type v for the project area and for the relevant calculation period, FRI_v, is calculated as detailed below.

When calculating FRI for the purpose of determining the relevant historical reference period, $FSA_{PA,BP,y,s}$ and $A_{PA,v}$ should be summed across all eligible veg types within the project area:

$$FRI_v = \frac{1}{\sum_s FF_{v,s}} \tag{1}$$

Where:

FRI_v	=	The mean Fire Return Interval for each vegetation fuel type *v* for the project area and for the relevant calculation period (years)
$FF_{v,s}$	=	the mean fire frequency of vegetation fuel type *v,* in fire season *s,* for the project area and for the relevant calculation period (years^{-1}) – from Equation (2)
v	=	Eligible vegetation fuel type
s	=	Fire season: Early dry season or late dry season

And:

$$FF_{v,s} = \frac{1}{n}\sum_{y=1}^{n} VTA_{p,b,v,y,s} \tag{2}$$

Where:

$FF_{v,s}$	=	Mean fire frequency of vegetation fuel type v, in fire season s, for the project area and for the relevant calculation period, (years^{-1})
$VTA_{p,b,v,y,s}$	=	Vegetation Type Area, in the calculation period p within boundary type b, covered by eligible vegetation fuel type v and observed to have burnt in year y during fire season s (unitless) – from Equation (3)
n	=	Length, in years, of the relevant calculation period
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
v	=	Eligible vegetation fuel type
y	=	Calendar year of the relevant calculation period
s	=	Fire season: Early dry season or late dry season

And:

$$VTA_{p,b,v,y,s} = \frac{FSA_{p,b,y,s}}{A_{b,v}} \quad (3)$$

Where:

$VTA_{p,b,v,y,s}$	Vegetation Type Area in the calculation period p within boundary type b, covered by eligible vegetation fuel type v and observed to have burnt in year y during fire season s (unitless)
$FSA_{p,b,y,s}$	Fire surface area in the calculation period p within boundary type b, observed to have burnt in year y during fire season s, in hectares – obtained through the procedures described in Appendix 2.
$A_{b,v}$	Total area in boundary type b covered by eligible vegetation fuel type v, in hectares - obtained through the procedures described in Appendix 2.
p	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
b	Boundary type: Project Area (PA) or Leakage Belt (LB)
v	Eligible vegetation fuel type
y	Calendar year of the relevant calculation period
s	Fire season: Early dry season or late dry season

(g) **(Quantitative guidance on establishing the baseline emissions prior to downward adjustment) -**

(i) **Baseline emissions prior to downward adjustment**

For all years y in the crediting period, Baseline emissions for the project area, prior to downward adjustment are calculated as follows:

$$BE_{HRP,y} = \overline{AHE}_{PA,HRP} \quad (4)$$

Where:

$BE_{HRP,y}$	=	Baseline Emissions for the Historical Reference Period (tCO_2e) for year y
$\overline{AHE}_{p,b}$	=	Average annual Historical Emissions from fires for calculation period *p*, within boundary type *b* (tCO_2e) – from Equation (5)

The Average annual Historical Emissions from fires are calculated as follows:

$$\overline{AHE}_{p,b} = \frac{1}{Y_{HRP}} \sum_{y=-Y_{HRP}}^{-1} E_{p,b,f,y} \quad (5)$$

Where:

$\overline{AHE}_{p,b}$	=	Average annual Historical Emissions from fires for calculation period *p,* within boundary type *b* (tCO_2e)
Y_{HRP}	=	Number of years to be considered in the Historical Reference Period, determined in accordance with Section 10.2.1
$E_{p,b,f,y}$	=	Annual emissions from fire in calculation period *p*, within boundary type *b*, in year *y* (tCO_2e) - from Equation (6)
p	=	Calculation period: Historical Reference Period
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
y	=	Years, with zero being the project start date.

(ii) **Fire Emissions**

The following equations and parameters are used when calculating annual fire emissions from eligible vegetation fuel types in eligible woody savanna ecosystems. They are applicable to both the Historical Reference Period and the Project Crediting Period.

Annual Emissions from fire in year y, of either the historical reference period or project crediting period, are calculated as follows:

$$E_{p,b,f,y} = \sum_{s} E_{p,b,f,y,s} \tag{6}$$

Where:

$E_{p,b,f,y}$	=	Annual emissions from fire in calculation period *p* within boundary type *b*, observed in year y, of either the historical reference period or the project period (tCO_2e)
$E_{p,b,f,y,s}$	=	Annual emissions from fire in calculation period *p* within boundary type *b*, observed in year y, for fire season s (tCO_2e) – from Equation (7)
p	=	Historical Reference Period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
y	=	Year 1, 2, 3, etc., starting on the project start date
s	=	Fire season: Early Dry Season or Late Dry Season

Annual Emissions from fires in either the Early Dry Season or the Late Dry Season are calculated as follows:

$$E_{p,b,f,y,s} = \sum_{v} PFE_{p,b,y,s} \times AB_{p,b,v,y,s} \tag{7}$$

Where:

$E_{p,b,f,y,s}$	=	Annual emissions from fire in calculation period *p* within boundary type *b*, observed in year y, for fire season s (tCO_2e)
$PFE_{p,b,y,s}$	=	Potential fire emissions in calculation period *p* within boundary type *b*, observed in y, for fire season s (tCO_2e/ha) — from Equation (9)
$AB_{p,b,v,y,s}$	=	Area Burned in calculation period *p* within boundary type *b*, of vegetation fuel type v, in year y, for fire season s (ha) — from Equation (8)
p	=	Calculation period: Historical Reference Period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
v	=	Vegetation fuel type, as defined in Appendix 1
y	=	Year 1, 2, 3, etc., starting on the project start date
s	=	Fire season: Early Dry Season or Late Dry Season

Area Burned of vegetation fuel type v, in year y, for fire season s is calculated as follows:

$$AB_{p,b,v,y,s} = FSA_{p,b,v,y,s} \times P_{v,s} \tag{8}$$

Where:

$\mathrm{AB}_{p,b,v,y,s}$	=	Area Burned in calculation period *p,* within boundary type *b*, of vegetation fuel type v, in year y, for fire season s (ha)
$FSA_{p,b,\mathrm{v},y,s}$	=	Fire surface area in calculation period *p,* within boundary type *b,* for vegetation fuel type v, observed to have burnt in year *y* during fire season *s* – obtained through the procedures described in Appendix 1.
$\mathrm{P}_{v,s}$	=	The appropriate Patchiness for eligible vegetation type *v* in fire season s (%) – from Appendix 1, Section 2
p	=	Calculation period: Historical Reference Period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
v	=	Vegetation fuel type, as defined in Appendix 1
y	=	Year 1, 2, 3, etc., starting on the project start date
s	=	Fire season: Early Dry Season or Late Dry Season

Potential fire emissions from eligible greenhouse gas g, in year y, for fire season s, are calculated as follows:

$$PFE_{p,b,g,y,s} = \sum_{g}\sum_{i}\sum_{v} BCE_{i,v,s} \times FL_{p,b,i,v,y,s} \times EF_{g,i,v,s} \times CC_{i,v,s} \times MtE_{g} \times EC_{g,i,v,s} \times GWP_{g} \quad (9)$$

Where:

$PFE_{p,b,g,y,s}$	=	Potential fire emissions in calculation period *p,* within boundary type *b*, from eligible greenhouse gas *g*, in year y, for fire season s (tCO_2e/ha)
$BCE_{i,v,s}$	=	Burning Consumption Efficiency for eligible fuel size class *i*, for eligible vegetation type v, in fire season s (%) — from Appendix 1, Section 2
$FL_{i,v,y,s}$	=	Fuel Load in calculation period *p,* within boundary type *b*, of eligible fuel size class *i,* from vegetation fuel type v, in year y, for fire season s (t/ha) – from equiation (10)
$EF_{g,i,v,s}$	=	Emission Factor for eligible greenhouse gas *g*, for eligible fuel size class *i*, for vegetation fuel type v, for fire season s (%) – from Appendix 1, Section 2
$CC_{i,v,s}$	=	Carbon Content for eligible fuel size class *i*, for vegetation fuel type v, for fire season s (%) – from Appendix 1, Section 2
MtE_g	=	Represents the ratio of molecular to elemental mass for greenhouse gas *g* – for CH_4=1.3333, and for N_2O=1.5714
$EC_{g,i,v,s}$	=	Is a ratio to convert other elements to carbon, for greenhouse gas *g*, for fuel size class *i*, for vegetation fuel type v, for season *s*. For CH_4, EC_{CH4} is the same for all vegetation fuel types v and fuel size classes *i* and is equal to 1. For N_2O, $EC_{N2O,v}$ is the nitrogen to carbon ratio, for vegetation fuel type v, for eligible fuel size class *i* – from Appendix 1, Section 2
GWP_g	=	Global Warming Potential of greenhouse gas *g* – as per the IPCC values
p	=	Calculation period: Historical Reference Period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
g	=	Means Methane (CH_4) or Nitrous Oxide (N_2O), or any other eligible greenhouse gas affected by fire seasonality, and does not include Carbon Dioxide (CO_2)
i	=	Fuel size class, e.g. fine fuel, shrub, etc. as per Appendix 1, Section 2
v	=	Vegetation fuel type, as defined in Appendix 1

y = Year 1, 2, 3, etc., starting on the project start date
s = Fire season: Early Dry Season or Late Dry Season

In the unexpected circumstances where a pixel is detected to burn twice in the same year, only account for the first occurrence.

In the context of SFM projects, fires are not expected to occur outside of the Dry Season period. However, wherever this is unexpectedly the case, fire events must be quantified as follows:

- Fires occurring after the midpoint of the wet season and before the start of the EDS must be accounted within the EDS period, and
- Fire occurring after the end of LDS and before the mid point of the wet season must be accounted within the LDS period.

(iii) **Fuel Load**

Refer to Appendix 1, Section 2 for the relevant Fuel Load values for each eligible fuel size class *i,* from vegetation fuel type v, in year y, for fire season s.

Note that some fuel size classes (e.g. fine and shrub) may present a significant relationship with the Years Since Last Burned (YSLB), and others (e.g. coarse and heavy fuels) may not, depending on the local environment. Where a significant relationship applies – refer to the steps below, otherwise – use the relevant $FL_{i,v,y,s}$ value irrespective of the YSLB.

(iv) **Fuel Load calculation process**

Where a significant relationship between Fuel Load and YSLB applies - to calculate $FL_{i,v,y,s}$ the activity participants must:

(a) produce a YSLB map for calendar year y in accordance with Appendix 2, or source such a map from a dMRV approved by PACM; and
(b) use that map to determine, for Years Since Last Burned values $YSLB$, for each vegetation fuel type v, and for calendar year y, the area burned, $AB_{YSLB,v,y}$, in accordance with Appendix 2 and
(c) use those areas burned to calculate the relevant Fuel Load, $FL_{i,v,y,s}$ for fuel size class *i*, for vegetation fuel type v, in calendar year y, and for fire season s – in accordance with Appendix 2.

(v) **Producing YSLB maps**

The YSLB map for calendar year y must:

(a) cover the project area; and
(b) be a geospatial map in raster format; and
(c) have a minimum resolution of 30x30m or less; and
(d) be produced using GIS software, and in accordance with the steps in this section.

Step *1* First, generate yearly fire maps, for calendar year y, and for each of the preceding calendar years, by aggregating monthly fire maps that are sourced from the approved dMRV for that year; or seasonal fire maps that were created using monthly fire maps and have been validated in accordance with Appendix 16.

The dataset should include any number of preceding years so that the number of pixels of 'unburnt' fuels over the full dataset is very low and as close to zero as possible (typically 5 years or more).

Note: where the relevant satellite data is not available for the required years, proponents may suggest an approach to fulfill the requirements. Such an approach must comply with the Rules, Modalities and Procedures Requirements and be included in the Project Description Document.

Step 2 Assign to each pixel of each yearly fire map a code as follows:

(a) if the code for that pixel in any of the maps used to create the yearly fire map is 'burned' — 'burnt';

(b) otherwise — 'unburnt'.

Step 3 Assign to each pixel of the YSLB map for year y a code (a years-since-last-burned value) as follows:

(a) if the code for the corresponding pixel of the yearly fire map for year y is 'burnt'; and in at least one of the yearly fire maps of the previous years, the code for the corresponding pixel is 'burnt'; and the most recent of those maps is for the year y − assign the corresponding number of years;

(b) if the code for the corresponding pixel of the yearly fire map for year y is 'burnt'; and no other of those yearly fire maps has a code 'burnt' for the corresponding pixel; assign the maximum number of previous years for which data is available (typically 5 years or more);

(c) if the code for the corresponding pixel of the yearly fire map for year y is 'unburnt' — assign the value '0' (zero).

(vi) **Calculating area burned for each YSLB value**

The area of each vegetation fuel type cohort by $YSLB$, vegetation type *v*, burnt in in year *y* during fire season *s* ($VCA_{YSLB,v,y,s}$) is determined by overlaying the YSLB map for year y with the vegetation fuel type map from Section 8.1.4.

(vii) **Fuel Load Calculation**

The Fuel Load $FL_{i,v,y,s}$ for fuel size class *i*, of vegetation fuel type v, in calendar year y in the Historical Reference Period or the project period, for fire season s, is calculated as follows:

$$FL_{p,b,i,v,y,s} = \frac{\sum_{YSLB} AB_{p,b,YSLB,v,y,s} \times FA_{YSLB,i,v,s}}{\sum_{YSLB} AB_{p,b,YSLB,v,y,s}} \quad (10)$$

Where:

$FL_{p,b,i,v,y,s}$	=	Fuel Load in calculation period *p,* within boundary type *b,* contained within eligible fuel size class *i,* from vegetation fuel type v, in year y, for fire season s (t/ha)
$AB_{p,b,YSLB,v,y,s}$	=	Area Burned, in calculation period *p* within boundary type *b,* for years-since-last burned value $YSLB$, for vegetation fuel type v, in year y (ha) – obtained through the procedures described in Appendix 2, and equation (8)
$FA_{YSLB,i,v,s}$	=	Fuel Accumulation value for years-since-last-burned value $YSLB$, for fuel size class *i*, for vegetation fuel

		type v, in fire season s (t/ha) — From Appendix 1, Section 2.
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
b	=	Boundary type: Project Area (PA) or Leakage Belt (LB)
YSLB	=	1, 2, 3, etc., Years Since Last Burned
i	=	Fuel size class, e.g. fine fuel, shrub, etc. as per Appendix 1, Section 2
v	=	Vegetation fuel type, as defined in Appendix 1
y	=	Year 1, 2, 3, etc., starting on the project start date
s	=	Fire season: Early Dry Season or Late Dry Season

Explanatory notes

- This subsection explicitly implements Baseline Standard 6.3.3(a) by addressing:
    - Minimum years (≥7, ideally 10–20, based on FRI multiples);
    - Year-on-year variability (inclusion of extreme years, statistical treatment);
    - Trends (dynamic or adjusted baselines where material);
- Performance improvements (adjustments for policy or sector-wide changes).
- Control group, model, and default factors are available as fallback options but are not the primary quantification method.
- This ensures baselines are robust, conservative, and aligned with ecological fire dynamics rather than anomalies or short-term cycles.

10.3. Calculation of the downward adjusted baseline

31. In accordance with Baseline Standard Section 7, the methodology applies a conservative downward adjustment to the baseline emissions derived from the historical reference period (HRP) average to ensure ambition is embedded in the baseline setting.

(a) **Downward adjustment in the first calendar year of the first crediting period:** In accordance with Section 7.1 of the Baseline Standard, the unadjusted historical baseline emissions ($BE_{HRP,y}$) determined under Section 10.2.2 shall be subject to a downward adjustment in the first crediting year. This ensures consistency with paragraph 33 of the RMPs, which requires that crediting baselines represent conservative estimates and incentivize ambition over time.

The downward adjustment is carried out through a step-wise procedure combining an uncertainty-based adjustment, and a minimum adjustment relative to ex-ante project emissions, with the final downward adjusted baseline taken as the minimum of the two values.

(i) **Step 1: Determine uncertainty in baseline emissions**: The activity participants must quantify the uncertainty at the lower bound of the uncertainty interval relative to the central estimate of the ex-ante quantified unadjusted net baseline emissions and/or removals at 95% confidence level during the first crediting period ($UNC_{BE\ HRP/hist,CP1}$). Uncertainty must cover all causes of uncertainty as per Section 4.13 of the Baseline Standard, including Burned area detection, Fuel load estimation, Combustion completeness, Emission factors, Patchiness and mapping errors. Further guidance on propagating error in uncertainty calculations is provided in Appendix 3.

(ii) **Step 2: Determine the downward adjusted baseline emissions based on uncertainty** for the calendar year of the start date of the first crediting period ($BE_{adj,UNC,y}$), as follows:

$$BE_{adj,UNC,y=1} = BE_{HRP,y=1} \times (1 - UNC_{BE\ HRP CP1}) \quad (11)$$

Where:

$BE_{adj,UNC,y}$	=	Downward adjusted baseline emissions based on uncertainty in year y (tCO_2e)
$BE_{HRP,y}$	=	Unadjusted existing historical baseline emissions in year y (tCO_2e) – from equation (4)
$UNC_{BE\ HRP CP1}$	=	Relative uncertainty fraction at 95% confidence level (%).
y	=	1. Calendar year of the start of the first crediting period.

(iii) **Step 3: Calculate the minimum adjustment relative to project emissions:**

$$BE_{adj,min,y=1} = BE_{HRP,y=1} - \left(BE_{HRP,y=1} - AE_y\right) \times 0.1 \quad (12)$$

Where:

$BE_{adj,min,y}$	=	Minimum downward adjusted baseline emissions in year *y* (tCO_2e).
$BE_{HRP,y}$	=	Unadjusted existing historical baseline emissions in year y (tCO_2e) – from equation (4)
AE_y	=	Ex-ante estimated project emissions in year y (tCO_2e), as per guidance in paragraph 47(b).
y	=	1. Calendar year of the start of the first crediting period.

(iv) **Step 4: Select the lower of the two values**

$$BE_{adj,y=1} = \min\{BE_{adj,UNC,y=1}\,; BE_{adj,min,y=1}\} \quad (13)$$

Where:

$BE_{adj,y=1}$	=	Final downward adjusted baseline emissions for year y (tCO_2e).
y	=	1. Calendar year of the start of the first crediting period.

(b) **Downward adjustment in subsequent years:**

In accordance with Section 7.2 of the Baseline Standard (paras. 65–71), downward adjustments must be applied in all calendar years following the start of the first crediting period. This ensures that credited baselines remain below business-as-usual (BAU) trajectories and that ambition increases progressively over time.

(i) **Definition of the annual conservative reduction rate.** After the initial adjustment in year 1, the baseline for each subsequent year shall decline by at least 1% of the initial downward-adjusted baseline. For savanna fire management projects, this methodology adopts an annual reduction approach to maintain continuity, transparency, and align with the annual calculations otherwise required by the methodology:

$$BE_{adj,y} = BE_{adj,y-1} \times (1 - r_y) \quad (14)$$

Where:

$BE_{adj,y}$	=	Downward adjusted baseline emissions for year y(tCO_2e).
r_y	=	for year y>1, annual conservative reduction rate (greater or equal to 0.01) as determined below.

(ii) **Determination of the components of the annual reduction rate r_y.** The determination of the downward adjustment shall be based on the cumulative effect of the following principles and considerations below, i.e.:

$$r_y = \sum_i r_{y,i} \quad (15)$$

Where:

i = The collection of all relevant principles and considerations

- **Economic viability.** SFM is a labour-intensive land management practice (community ranger teams, prescribed burning, monitoring), that requires ongoing reinvestment in land management infrastructure (roads, fences) training and community development. Economic viability is generally marginal, and there generally are no other sources of revenue than the sale of carbon credits. Therefore, in general, this principle does not justify increasing the annual reduction rate beyond its minimum annual value.

  However, if a project benefits from other sources of funding (e.g. fire management grants) in any given year, proponents shall set the annual reduction rate in such a way that the crediting baseline is reduced by an amount equal to the additional funding received that year – having regards to the actual sales price of carbon credits achieved by the project.

  Where the other sources of funding are later discontinued in year y=Y, the proponents may recalculate $BE_{adj,\mathrm{Y}}$ using the minimum rate of 0.01 for all years preceding.

  For example, assuming $BE_{adj,y-1}$ = 50,000 tCO_2-e, and the actual sales price of credits is USD$20/ tCO_2-e, if the project receives a grant of $20,000 towards the delivery of EDS burning operations, then $BE_{adj,y}$ must be reduced by $20,000/$20 = 1,000tCO_2-e, and $r_{y,economic\ viability} = \frac{1,000}{50,000} = 0.02$.

- **Incentives for less GHG-intensive practices.** While EDS fires are less emissions intensive that LDS fires, they remain a GHG-intensive activity. The methodology rewards a reduction in the both the extent and severity of fires, but this may also create an incentive to undertake more EDS burns than necessary to achieve the carbon abatement outcome, or more EDS burns than is beneficial to the ecosystems. This is particularly true around key fire breaks areas like road fences and project boundaries.

  To create an incentive for more fine scale fire management, activity participants must assess the area that remains unburnt for 2years or more for each year in the crediting period. If that area is greater than during the Historical Reference Period (i.e. there is less fire overall), then minimum rate of 0.01 applies. Conversely, if that area is lower than during the Historical Reference Period (i.e. there is more fire overall) then proponents shall set the annual reduction rate in such a way that the crediting baseline is reduced by an amount equal to the increase in burned area, converted to tCO_2-e using the equations in this methodology.

For example, assuming $BE_{adj,y-1}$ = 50,000 tCO_2-e; that during the HRP the average size of the project area unburnt for more than 2years was 40,000ha; and that in year y of the crediting period, only 35,000ha remains unburnt for more than 2years. Assuming further that the equations lead to a result whereby 1ha burned in year y equals 0.2tCO_2-e/ha on average, then $BE_{adj,y}$ must be reduced by (40,000-35,000)ha x 0.2 tCO_2-e/ha = 1,000 tCO_2-e and $r_{y,GHG\ intesive\ practices} = \frac{1,000}{50,000} = 0.02$

- **Established long-term pathways.** Many host countries (Australia, Zambia, Mozambique, Brazil) already include fire management in NDCs or land sector pathways. These often assume progressive reductions in LDS fire emissions, but they are also often conditional to the availability of climate finance. Downward adjustment trajectories should be aligned with host-country NDC/LT-LEDS.

  For example, if a Host Party's pathway requires a 20% reduction over 10 years, then the methodology should enforce at least a 2% annual downward adjustment, and $r_{y,Host\ Party's\ pathways} = 0.02$. However, if that commitment is subject to the availability of climate finance, then the minimum rate applies: $r_{y,Host\ Party's\ pathways} = 0$.

- **Consideration of concept of sufficiency (IPCC AR6 WGIII, Chapter 9).** The sufficiency concept highlights reducing overall resource and emissions intensity rather than maximizing outputs. In SFM, sufficiency translates into maintaining ecological fire regimes that minimize GHG emissions while supporting biodiversity and community resilience. In high-consumption, well-resourced contexts, there is capacity for higher ambition because institutional and technical capacities are mature. In low-resource contexts, sufficiency may mean prioritizing livelihood security and biodiversity protection while progressively scaling ambition.

  The annual reduction rate of the downward adjustment factor shall be stratified by the regional context for the project area. In high-capacity, high-consumption settings, $r_{y,sufficiency\ max} = 0.02$. In low-resource, subsistence-oriented settings, to avoid undermining viability $r_{y,sufficiency\ min} = 0$. Activity participants must provide information and analysis to justify their choice of rate between those two boundaries.

- **Consideration of suppressed demand.** Many savanna regions face suppressed demand for fire management due to lack of resources, governance gaps, or limited funding. In these cases, baseline emissions are high not because of overconsumption, but because of under-capacity to implement prescribed burning. Where suppressed demand is demonstrated (e.g., lack of fire management infrastructure, no existing ranger programs), a lower downward adjustment trajectory may apply through the application of a negative annual reduction rate – within the limitation of ensuring that the net annual reduction rate of r_y must still be ≥0.01 per year as a minimum. This ensures projects remain viable while still ensuring ambition.

- **Project Specific considerations.** Activity participants shall identify any other project specific consideration that meet the requirements of the Baseline standard to "encourage ambition over time" and "ensure that the baseline is below BAU". Activity participants shall specify the factors or quantitative methods to calculate the annual reduction rate $r_{y,project\ specific}$ contribution to the downward adjustment.

This may include the development of a bespoke annual rate of reduction for the project to give effect to the stepwise procedure for determining the crediting baseline under section 5.2 of the Baseline standard which - in instances where the downward adjusted baseline does not result in numerical value lower than the numerical value of the conservative BAU baseline (sections 10.4 and 10.5) – requires activity participants to apply a further adjustment to ensure that the downward adjusted baseline is lower than the conservative BAU baseline.

32. Explanatory Notes

- The downward adjustment is determined and applied in accordance with Section 7 of the Baseline Standard, ensuring that baselines are set conservatively and decline over time to encourage ambition. The adjustment consists of two stages:
- Initial downward adjustment (Section 7.1): Baseline emissions from the Historical Reference Period are first subject to an uncertainty-based adjustment using the lower bound of the 95% confidence interval. A minimum adjustment relative to ex-ante project emissions is also applied. The final adjusted baseline in year 1 is the lower of the two values.
- Downward adjustment in subsequent years (Section 7.2): From year 2 onwards, the baseline is progressively reduced by applying an annual conservative reduction rate r_y no smaller than 1% of the initial adjusted baseline, consistent with para. 71 of the Standard. The reduction rate r_y incorporates the cumulative effect of multiple considerations.
- The procedure guarantees that the crediting baseline in each year of the crediting period is conservatively adjusted downward, reflecting both statistical robustness (via uncertainty) and ambition over time (via progressive reduction).
- The combined equations ensure that the resulting baseline is always below the conservative BAU level and compliant with paras. 65–71 of the Baseline Standard.

10.4. Identification of the conservative BAU scenario

33. In accordance with Baseline Standard Section 8, this methodology requires the identification of a conservative Business-as-Usual (BAU) scenario to demonstrate that the downward-adjusted baseline (Section 10.3) is lower than BAU. The BAU scenario represents the emissions trajectory that would occur in the absence of the Article 6.4 activity and is determined using the following procedure.

The BAU scenario is determined by evaluating the plausible counterfactuals listed in para. 73 of the Standard.

For Savanna Fire Management (SFM), the most appropriate scenario is "Continuation of the historical situation (pre-activity scenario)", representing unmanaged or poorly managed savanna fire regimes dominated by Late Dry Season (LDS) burning. In cases where host country policy frameworks (e.g., NDCs, LT-LEDS, or land-sector regulations) mandate progressive improvement in fire management, the BAU scenario shall incorporate these policies as per para. 76.

Where multiple plausible scenarios exist, the methodology requires that the most conservative scenario (i.e., highest emissions trajectory consistent with BAU conditions) be selected (para. 74).

This scenario identification is achieved through four complementary assessments:

(a) **Trend analysis:**

- Historical Reference Period (HRP) fire emissions are statistically tested for significant upward or downward trends (e.g., regression analysis at 95% confidence).
- If a downward trend is observed (e.g., progressive reduction in LDS burned area), the BAU scenario is adjusted downward to reflect this.

(b) **Structural change and policy analysis**

- National or sectoral policies, measures, or structural changes that may influence future fire regimes are assessed.
- Examples include government-led prescribed burning, land tenure reforms, or climate adaptation strategies.
- If such measures indicate that emissions will decline under BAU conditions, the baseline is adjusted accordingly.

(c) **Policy and planning screen (NDC/LT-LEDS alignment)**

- Activity participants must demonstrate that the downward adjusted baseline trajectory does not exceed the mitigation ambition embedded in the host Party's Nationally Determined Contribution (NDC) or Long-Term Low Emissions Development Strategy (LT-LEDS).
- This assessment must include:
    - Current NDC targets relevant to the AFOLU or fire management sector.
    - Long-term decarbonization pathways in the LT-LEDS, where available.
    - Any sectoral ceilings, caps, or fire-management commitments formally adopted by the host Party.

(d) **Quantitative benchmarking**

- Where sector-level or national reference pathways exist, the downward adjusted baseline trajectory must be compared against these benchmarks.
- The adjusted baseline must not be higher than the NDC/LT-LEDS pathway; if it is, it must be conservatively adjusted downward to match or fall below the benchmark.

34. **Explanatory Notes**

- Conservativeness principle: Where data gaps prevent full application of trend, policy, or benchmarking analysis, the methodology defaults to the most conservative trajectory available.
- Alignment with host Party commitments: Embedding NDC/LT-LEDS alignment ensures that credited emission reductions represent efforts beyond BAU policies and contribute to—but are not double counted within—host Party targets.
- Host-country dataset requirement: Proponents must provide host-country specific datasets at the project validation stage to operationalize the BAU test. These include: NDC sectoral benchmarks; LT-LEDS fire management strategies; and AFOLU ceilings or other relevant planning documents.
  This requirement ensures practical alignment between the baseline trajectory and host Party climate commitments.
- This section explicitly incorporates (i) trend testing, (ii) structural/policy assessment, and (iii) NDC/LT-LEDS alignment, strengthening the methodology's robustness and ensuring international compliance.

10.4.1. Calculation of the conservative BAU emissions

35. The BAU scenario and quantification of the BAU emissions and/or removals shall be determined both Ex ante in the PDD at the start of the first crediting period for the same

duration as the crediting period of the proposed Article 6.4 activity, specifying the BAU emissions for each calendar year within the crediting period; and ex post for each calendar year within the crediting period.

The BAU scenario shall be redetermined at each crediting period renewal and the same analysis shall be carried out.

The Calculation of the conservative BAU emissions follows the stepwise procedure below.

(a) **Step 1- Quantify of BAU Emissions.** Following the identification of the most likely Business-as-Usual (BAU) scenario, emissions are calculated by adjusting the Baseline Emissions for the Historical Reference Period (BE_{HRP}, from equation (4)) based on observed statistical trends and/or policy and programmatic interventions that are expected to affect fire regimes in the absence of the project. The general formulation is:

$$BAU_y = BE_{HRP} \times f(\text{Trend}_y, \text{Policy}_y) \quad (16)$$

Where:

- BAU_y= Most likely BAU emissions in year y (tCO_2e)
- BE_{HRP}= Baseline Emissions for the Historical Reference Period (tCO_2e) – from equation (4)
- $f(\text{Trend}_y, \text{Policy}_y)$= adjustment function derived from the analyses (a) – (d) in the section above, to be determined by the activity participants and validated by the DOE on first verification.

Application rules:

- If no statistically significant trend is detected and no relevant policies are identified, then: $BAU_y = BE_{HRP,y}$
- If a downward or upward trend in HRP emissions is identified (e.g., decreasing LDS fire area), the BAU is adjusted downward by the projected rate of decline, as long as the trend is material (+/- 5%).
- If policies/programs (e.g., nationally mandated prescribed burning programs, AFOLU emission caps, or LT-LEDS sectoral ceilings) indicate expected reductions, BAU is adjusted downward to reflect these.
- If both apply, the most conservative (lowest) estimate is taken, in accordance with Baseline Standard para. 77(a).

(b) **Step 2 - Determine the conservative BAU baseline emissions based on uncertainty.**

(i) First, determine the uncertainty at the lower bound of the uncertainty interval relative to the central estimate of the ex-ante quantified BAU net baseline emissions during the first crediting period $UNC_{BAU,CP1,y}$. The determination of the uncertainty shall consider all causes of uncertainty as per paragraph 13 in Appendix 1 of the baseline standard;

(ii) Determine the conservative BAU baseline emissions and/or removals based on uncertainty for the relevant year or period $BAU_{cons,UNC,y}$ as follows:

$$BAU_{cons,UNC,y} = BAU_y \times (1 - UNC_{BAU,CP1,y}) \quad (17)$$

Where:

- $UNC_{BAU,CP1,y}$= Uncertainty at the lower bound of the uncertainty interval relative to the central estimate of the ex-ante quantified most likely net

BAU baseline emissions and/or removals during the first crediting period year y (fraction)

- $BAU_{cons,UNC,y}$= Conservative BAU baseline emissions and/or removals based on uncertainty in year y
- BAU_y = Most likely BAU baseline emissions in year y – from equation (16)
- y = Relevant year or period

(c) **Step 3 - Determine the minimum conservative BAU baseline emissions** during the first crediting period as follows:

$$BAU_{cons,min,y} = BAU_y - (BAU_y - AE_y) \times 0.1 \tag{18}$$

Where:

- $BAU_{cons,min,y}$ = Minimum conservative BAU baseline emissions and/or removals in year y
- AE_y= Activity emissions in year y
- y = Relevant year or period

(d) **Step 4 - Select the lower of the two values**. Compare the conservative BAU baseline emissions based on uncertainty $BAU_{cons,UNC,y}$ and the minimum conservative BAU baseline emissions $BAU_{cons,min,y}$ and select the lower as the conservative BAU baseline emissions:

$$BE_{cons,y} = \min\{BAU_{cons,UNC,y}, BAU_{cons,min,y}\} \tag{19}$$

Where:

- $BE_{cons,y}$ = Conservative BAU baseline emissions in year y
- y = Relevant year or period

(e) **Guidance on Ex-post Quantification of the BAU Baseline.** In accordance with the Baseline Standard, the methodology specifies which parameters for the determination of the conservative BAU baseline are fixed ex-ante for the duration of the crediting period and which parameters are updated on an ex-post basis for each calendar year (or at another defined frequency). This ensures transparency, reproducibility, and conservativeness in BAU estimation.

(i) Parameters determined ex-ante (fixed for the crediting period). The following parameters are determined prior to the start of the first crediting period and remain fixed for its duration:

- Historical Reference Period (HRP): The number of years and the start and end dates of the HRP are defined ex-ante.
- Vegetation Fuel Type (VFT) stratification: Eligible fuel types, their mapped extents, and classification rules.
- Emission factors (EFg,s,v,i): Gas-, season-, vegetation-, and fuel-class specific values, derived from peer-reviewed literature, IPCC defaults, or national Tier 2/Tier 3 values where available.
- Combustion completeness and carbon content factors (BCE, CC): Default or host-country approved constants.
- Global Warming Potentials (GWPg): Fixed as per the latest IPCC Assessment Report adopted under the UNFCCC at the start of the crediting period.
- Patchiness factors (P(v,s)): Stratified by vegetation type and fire season, derived from ecological studies or national datasets.

(ii) Parameters updated ex-post (annually) The following parameters are determined ex-post during each calendar year of the crediting period to reflect actual BAU conditions and inter-annual variability:

- Burned Area (FSAp,b,v,y,s): Quantified annually through Earth Observation (e.g., MODIS, Sentinel-2, Landsat) validated by QA/QC protocols (≥80% accuracy).
- Fuel Load (FLi,v,y,s): Updated annually using Years Since Last Burn (YSLB) maps, field sampling, or dMRV systems where available.
- Years Since Last Burn (YSLB): Updated annually through geospatial overlay of fire history and vegetation maps.
- Trends and policy adjustments: Any national fire management policies, NDC/LT-LEDS targets, or sectoral regulations scheduled to take effect within the crediting period are incorporated annually, unless explicitly conditional on Article 6.4 finance.
- Uncertainty estimates ($UNC_{BAU,CP1,y}$) Recalculated ex-post using statistical error propagation covering burned area detection, fuel load, emission factors, and mapping errors.

(iii) Frequency of updates:

- Annual updates: Burned area, fuel load, YSLB, and uncertainty.
- Crediting period updates: Vegetation maps and policy/sectoral alignment checks.
- Fixed ex-ante for full crediting period: Emission factors, combustion factors, patchiness factors, GWP values.

(iv) Equations application. The ex-post conservative BAU baseline for year y is determined by re-applying the equations of this Section 10.4.1 using the updated ex-post parameters alongside fixed ex-ante values.

36. **Explanatory Notes:**

- The conservative Business-as-Usual (BAU) baseline is required under Section 8 of the Baseline Standard to demonstrate that the downward adjusted baseline (Section 10.3) is more ambitious than what would plausibly occur in the absence of the Article 6.4 activity.
- Choice of BAU scenario: Continuation of the historical fire regime is the most appropriate for SFM because the activity does not involve new technologies but alters management of fire timing and extent.
- Quantification approach: Site-specific HRP data is used as the core basis, with adjustments for policy and ecological trends ensuring realism and conservativeness.
- Uncertainty & conservativeness: Both uncertainty treatment and minimum adjustment relative to project emissions ensure that the BAU scenario cannot inflate potential credits.
- Outcome: The methodology guarantees that credited emission reductions are strictly below BAU, fully compliant with paras. 72–77 of the Baseline Standard.
- Guidance on ex-post quantification of the BAU Baseline ensures that structural constants (factors unlikely to vary annually) are fixed ex-ante, while dynamic parameters (burned area, fuel load, YSLB, policy drivers) are updated ex-post to reflect actual conditions. This approach is consistent with the Baseline Standard requirement for ex-post quantification of BAU emissions and guarantees that the crediting baseline remains both below BAU and progressively conservative.

10.5. Comparison of the downward adjusted baseline and the conservative business-as-usual baseline

37. In accordance with section 9 of the Baseline Standard, project participants must undertake:

(a) **An ex-ante comparison at validation** of the two baseline trajectories in the Project Design Document (PDD): between the downward adjusted baseline emissions ($BE_{adj,y}$) derived from Section 10.3, and the conservative BAU baseline emissions ($BE_{cons,y}$) determined in Section 10.4.

For each year of the crediting period, $BE_{adj,y}$ must be strictly lower than $BE_{cons,y}$.

In addition, the cumulative sum of $BE_{adj,y}$ over the full crediting period must also be lower than the cumulative sum of $BE_{cons,y}$.

If, for any year or cumulatively, the conservative BAU baseline is lower than the downward adjusted baseline, the methodology requires the project participant to return to Section 10.3, and revise the quantitative methods or factors used to determine the downward adjustment.

This iterative revision must continue until the downward adjusted baseline is consistently lower than the conservative BAU baseline in both annual and cumulative terms.

(b) **Ex-post comparison at monitoring** of the two baseline trajectories in each monitoring report: $BE_{adj,y}$ (ex-post downward adjusted baseline), and $BE_{cons,y}$ (ex-post conservative BAU baseline)

For each calendar year of the crediting period, project participants must demonstrate that: $BE_{adj,y} < BE_{cons,y}$.

If the condition is not met for a given year, the methodology requires that the conservative BAU baseline ($BE_{cons,y}$) shall be used as the crediting baseline for that year. This ensures that credited reductions remain conservative even if ex-post data diverge from ex-ante projections.

Application and transparency. Both the ex-ante and ex-post comparisons must be documented in the PDD and subsequent monitoring reports, including full datasets, assumptions, and uncertainty calculations. Where revisions are triggered, proponents must transparently report the adjustment process, justification, and updated values. DOE/AE shall confirm compliance with the requirement that the final crediting baseline remains below the conservative BAU baseline for all years.

38. **Explanatory Notes:** This section operationalises the Step 5 comparison requirement of the Baseline Standard by:

- Requiring ex-ante comparisons to ensure that the initial downward adjusted baseline is already below BAU at validation.
- Requiring ex-post annual comparisons to ensure ongoing compliance with conservativeness during monitoring.
- Mandating that if $BE_{adj,y}$ is not lower than $BE_{cons,y}$, then either (i) the downward adjustment must be recalculated (ex-ante), or (ii) the BAU baseline must be adopted as the crediting baseline (ex-post).

- This dual safeguard ensures that crediting baselines are always more ambitious than business-as-usual trajectories, preventing over-crediting and maintaining environmental integrity.

11. Activity scenario

11.1. Calculation of activity emissions

39. For each year of the crediting period, Project Emissions (PE_y) are calculated as the sum of:

$$PE_y = E_{p,b,f,y} + PE_{FC_y} + PE_{EC_y} \tag{20}$$

Where:

PE_y	=	Project Emissions in year y (tCO_2e)
$E_{p,b,f,y}$	=	Annual emissions from fire in calculation period *p*, within boundary type *b*, observed in year *y* (tCO_2e) - derived from Equation (6) in the Baseline Scenario section
PE_{FC_y}	=	Emission from fossil fuel combustion in year y (tCO_2e) – from equation (21(21)
PE_{EC_y}	=	Emissions from electricity consumption in year y (tCO_2e) - from equation (22(22)
p	=	Calculation period: Crediting Period (CP)

Emissions from fossil fuel combustion ($PE_{FC,y}$) from vehicles and aerial ignition, and electricity consumption ($PE_{EC,y}$) for monitoring and operations are included but expected to be immaterial. Emissions are estimated using fuel/electricity consumption multiplied by the relevant IPCC default factors:

$$PE_{FC,y} = FC_y \times EF_{FC} \tag{21}$$

$$PE_{EC,y} = EC_y \times EF_{EC} \tag{22}$$

Where:

- $PE_{FC,y}$ = Emissions from fossil fuel combustion in year y (tCO_2e)
- FC_y= Fuel consumption in year y (litres) – in line with monitoring requirements
- EF_{FC}= Emission factor for fossil fuels (tCO_2e/L)
- $PE_{EC,y}$ = Emissions from electricity consumption in year y (tCO_2e)
- EC_y= Electricity consumption in year y (kWh) – in line with monitoring requirements
- EF_{EC}= Emission factor for electricity, host-country grid (tCO_2e/kWh)

40. **Explanatory notes**

- Consistency: Fire emissions within the project boundary are calculated using the same stratification (vegetation fuel type, YSLB, patchiness) and equations as the baseline scenario, ensuring comparability.

- Seasonal disaggregation: EDS and LDS are disaggregated to reflect the emissions reduction logic of SFM. Where seasonal distinction cannot be fully applied, the higher LDS emission factor is conservatively used.
- Defaults: Fuel load (FL), combustion efficiency (CE), and emission factors (EF) are set ex-ante at methodology level but can be updated if host-country or IPCC Tier 2/3 data are available.
- QA/QC: Burned area data must meet ≥80% mapping accuracy, with cross-sensor checks and confusion matrices. Annual monitoring must reconcile fuel load with Years Since Last Burn (YSLB) to maintain temporal accuracy.
- Treatment of immaterial sources: Fossil fuel and electricity emissions are included for completeness but can be conservatively assumed negligible where demonstrated.
- Safeguards: Exclusion of biogenic CO_2, inclusion of only CH_4 and N_2O, and conservative defaults align with Methodologies Standard paras. 27–28 on conservativeness and environmental integrity.

12. Leakage

12.1. Identification of leakage emission sources

41. In accordance with the PACM Leakage Standard (A6.4-STAN-METH-005), all potential sources of leakage relevant to savanna fire management (SFM) are assessed:

- **(Baseline equipment transfer)** *Not applicable*. SFM does not involve the replacement or transfer of baseline equipment that could continue to operate outside the activity boundary. Ignition tools and vehicles used for prescribed burns are the same as in baseline fire management and do not generate incremental off-site emissions. This source is conservatively excluded.

- **(Competition for resource use)** Not applicable. SFM does not divert biomass or other natural resources from alternative uses. The activity changes fire timing and intensity but does not increase demand for biomass, energy, or scarce inputs. This source is conservatively excluded.

- **(Diversion of existing production processes or outputs : activity-shifting leakage):** Applicable and material. The primary leakage risk is displacement of late dry season (LDS) fires to unmanaged lands adjacent to the project boundary, or the spillover of additional early dry season (EDS) fires from the project area into adjacent land. For example, if project activities reduce LDS ignitions inside the project area but fire-setting agents simply move those ignitions into the surrounding landscape, off-boundary LDS emissions may increase. This source is explicitly addressed through (a) applicability condition “leakage – project activities”, or (b) establishment and monitoring of a Leakage Belt (see Section 12.2).

- (**Increases in GHG release from the environment)** Not applicable. SFM does not trigger hydrological or ecological disturbances outside the project that would cause off-site carbon stock losses. Early dry season (EDS) burns are cooler and patchier, with no evidence of increasing erosion or soil organic carbon release beyond the boundary. Conservatively excluded.

- **(Positive leakage - spillover benefits**) Documented but not credited. Evidence from Australia shows that SFM can create spillover benefits beyond project boundaries, such as reducing the probability of large LDS wildfires entering adjacent lands and diffusion of prescribed burning practices among neighbouring communities. Under PACM rules, such positive leakage is identified and reported but excluded from crediting, with the net effect of setting leakage to zero where positive effects exceed negative leakage.

- **(International leakage)** For projects near international borders, proponents must assess the plausibility of cross-border leakage (e.g., displaced LDS fires). Where the Leakage Belt extends into another jurisdiction, proponents must document arrangements for data access or apply conservative assumptions (e.g., assume no monitoring data, set leakage ≥ 0). Specific worked examples are to be developed in consultation with host Parties.

- **(Attribution considerations)** Where observed changes in the Leakage Belt reflect external land-use policies (e.g., government fire bans, grazing restrictions, landholders action) rather than project influence, proponents must provide evidence of attribution. Attribution analysis shall use:
  - Regional fire statistics and policy documentation;
  - Stakeholder engagement records; and
  - Comparison with control areas outside the LB.
  - Where attribution to the project cannot be clearly demonstrated, such changes shall be conservatively treated as unrelated and excluded from leakage accounting.

42. **Explanatory Notes**
    - This structure aligns directly with paragraph 12 of the Leakage Standard, requiring comprehensive identification of potential sources and justification for exclusion.
    - Only activity-shifting leakage (LDS displacement) is applicable, consistent with both the scientific literature and the Secretariat's feedback.
    - The Leakage Belt definition has been clarified (≥10 km buffer, equal area to project, entry-point option) and its monitoring system is harmonized with project MRV to ensure comparability.
    - Positive leakage is transparently documented (per the Leakage Standard's summing rule) but not credited.
    - A specific requirement has been added for international leakage assessment, addressing a noted gap in prior drafts.

12.2. Avoidance or minimization of leakage

43. To avoid or minimize negative leakage, the methodology requires activity participants to:

(a) Project activities: Design and implement project activities in such a way that prescribed fires are kept within the project area through the establishment of boundary fire breaks and the prohibition of burning outside of the project area. Through these provisions, SFM projects will be able to avoid or minimise the displacement of late dry season (LDS) fires to unmanaged lands adjacent to the project boundary, or the spillover of additional early dry season (EDS) fires from the project area into adjacent land.

(b) Stakeholder engagement: Undertake stakeholder engagement to coordinate fire management activities and reduce the risk of displaced ignitions. This includes obtaining applicable fire permits or authorisations from the relevant fire or land agencies. Through this provision, SFM projects will be able to support regional fire management planning and reduce the risk of uncontrolled fires.

44. **Explanatory Notes**
    - This approach aligns with paragraph 14 of the Leakage Standard, which requires methodologies to define measures for avoiding or minimizing leakage.
    - Stakeholder engagement provisions reflect best practice in Australia, Southern Africa & Brazil, where coordination with neighbours has reduced off-boundary leakage risks.

12.3. Addressing leakage emissions

45. Where activity-shifting leakage cannot be avoided or minimized, it shall be quantified annually and deducted from project emission reductions in line with Section 5.3 of the Leakage Standard, following the below procedure:

Establishment of a Leakage Belt

A Leakage Belt (LB) surrounding the project area must be defined as follows:

(a) Extent: The LB must extend at least 10 km outward from the project boundary and have an area equivalent to the project area, ensuring proportional coverage, and

(b) Stratification: The LB must be stratified using the same eligible savanna vegetation fuel types and fire age classes as the project area, to ensure comparability of emission estimates.

Calculation of leakage

Where negative leakage cannot be avoided through the measures in section 12.2 above, and the savanna fuels in the LB are material, the net leakage is calculated using a leakage belt-based comparison against the Historical Reference Period (HRP):

$$LEAK_y = \max\{0, E_{LB,y} - \overline{E_{LB,HRP}}\} \quad (23)$$

Where:

- $LEAK_y$ = Net leakage in year *y* (tCO_2e)
- $E_{LB,y}$ = fire emissions in year y of the Crediting Period in the Leakage Belt as a direct result of project activities– applying equation (6) to the Leakage Belt area
- $\overline{E_{LB,HRP}}$ = mean fire emissions in the Leakage Belt during the HRP – applying equation (6) to the Leakage Belt area

If net leakage is ≤ 0 (i.e., positive or no leakage occurs), leakage is set to zero in accordance with PACM rules, ensuring that positive spillover effects are not credited but also not penalized.

Monitoring: Monitoring of the Leakage Belt mirrors the project area requirements to ensure consistency:

(a) Data and parameters not monitored: as per section 14.

(b) Data and parameters monitored: as per section 15, applied to the LB area.

(c) Note that only fires displaced from within the Project Area into the LB are applicable. Fires coming from outside the LB are not considered a project leakage source. This can be monitored through timeseries of satellite imagery showing ignition point.

(d) Tools and sources: as per section 15, monthly Earth Observation data (MODIS, Sentinel-2, Landsat), with seasonal aggregation into EDS/LDS periods.

(e) QA/QC: minimum map accuracy using confusion matrices, cross-sensor checks, transparent metadata (data vintages, algorithms), and field verification where feasible – see mapping guidelines in Appendix 2.

(f) All monitoring datasets, intermediate calculations, and final leakage estimates must be archived for audit in line with PACM requirements, and made available to the DOE during validation and verification.

46. Explanatory Notes

- By standardizing the LB design and stratification, the methodology ensures consistent monitoring of activity-shifting leakage, addressing the only material source identified under Section 12.1.
- This procedure ensures that only material negative leakage is deducted, in accordance with para. 27–30 and Section 5.3 of the Leakage Standard.
- The use of the HRP mean as a benchmark ensures consistency between project and baseline leakage conditions.
- Positive leakage (e.g., spillover adoption of EDS burning by neighbouring landholders) is transparently reported but excluded from crediting, consistent with PACM rules.
- The design ensures that monitoring of the Leakage Belt is methodologically identical to the project area, addressing Secretariat concerns on comparability.
- This conservative approach ensures that reported emission reductions are not overstated and that environmental integrity is preserved.

13. Emission reductions

47. Emission reductions are determined annually and aggregated over the crediting period to establish the total volume of Article 6.4 Emission Reductions (A6.4ERs) that may be issued. In line with Section 9 of the Baseline Standard and paragraph 31–34 of the Methodologies Standard, net emission reductions are calculated as:

$$ER_y = (BE_{adj,y} - PE_y - LEAK_y) \qquad (24)$$

Where:

- ER_y= Emission Reductions in year *y* (tCO_2e)
- $BE_{adj,y}$= The downward adjusted baseline emissions in year y (tCO_2e) – in line with the requirements of Section 10.5
- PE_y= Project emissions in year *y* (tCO_2e) - from equation (20)
- $LEAK_y$= Net leakage in year *y* (tCO_2e) – from equation (23). If $LEAK_y \leq 0$, it is conservatively set to zero.

(a) **Cumulative GHG Emissions Reduction Crediting Test.** To ensure environmental integrity in years where project emissions may exceed baseline emissions (e.g., due to atypical LDS fire events), a cumulative crediting safeguard is applied in line with Baseline Standard para. 60.

First, cumulative emission reductions since the start of the project are calculated as follows:

$$C_{ER,y} = \sum_{y=1}^{y} ER_y \qquad (25)$$

Where:

$C_{ER,y}$ = Cumulative GHG Emissions Reduction in year y (tCO_2e)

ER_y = Emissions Reduction in year y (tCO_2e) – from equation (24)

Then, the following crediting test is applied. This step ensures that issuance does not occur unless the cumulative balance remains positive, preserving conservativeness across the crediting period:

Condition	Crediting rule: the number of Article 6.4 Emission Reductions (A6.4ERs) that may be issued is
$ER_y < 0$	A6.4ERs = 0 (zero: no issuance for that year)
$C_{ER,y} \geq 0 \; and \; ER_y \geq 0$	A6.4ERs = ER_y
$C_{ER,y} < 0, and \; ER_y \geq 0$	A6.4ERs = 0 (zero: no issuance for that year)

(b) **Guidance on Ex-Ante Estimation of emission reductions**

The project description must include an ex-ante estimation of emission reductions (AE_y) outlining a scenario of future fire performance over the full crediting period - specifically the proportion of eligible vegetation fuel that will be burnt in the Early Dry Season and the Late Dry season.

In developing such a scenario, projects must consider the following requirements and assumptions:

- Estimate must be produced for the full crediting period.
- The Vegetation Fuel Type Map remains unchanged during the crediting period.
- The project reduction in fire emissions must be based on credible operational assumptions, e.g.,
    - The proportion of EDS burns during the project activities (as a percentage of total eligible vegetation fuel type area) will increase to equal the proportion of LDS burns during the Historical Reference Period;
    - The proportion of LDS burns (as a percentage of total eligible vegetation fuel type area) will decrease to less than 5%;
- There will be no volatility in the performance of the project, i.e., both proportions listed in items a) and b) above will remain constant during the crediting period;
- Assume that in the absence of project, the area will maintain its average historical proportions of EDS and LDS burns.
- The ex-ante estimate of reductions is derived using equation (24);
- All other parameters remain constant, and there will be no leakage, or uncertainty discount.

48. **Explanatory notes**

- Baseline emissions (BE): Derived from the Historical Reference Period (HRP, 10–15 years), with downward adjustment and conservative BAU screening (per paragraphs 59–60, 76–77 of the Baseline Standard).
- Project emissions (PE): Include EDS and LDS fire emissions within the project boundary, disaggregated by vegetation fuel type, fuel load, patchiness, and Years Since Last Burn (YSLB). Direct fossil fuel use for project operations (vehicles, aerial ignitions) is included but expected to be de minimis.
- Leakage (LEAK): Only activity-shifting LDS fires in adjacent unmanaged savannas are considered. Leakage is quantified via a Leakage Belt (≥10 km), with positive leakage (spillover benefits) recorded but excluded from crediting in line with Leakage Standard para. 29.
- Conservativeness: Where uncertainty arises, conservative defaults are applied, including: exclusion of biogenic CO_2 (assumed reabsorbed during wet season), setting

negative leakage to zero, and prioritizing higher emission factors (e.g., LDS defaults where seasonal distinction is uncertain).

14. Data and parameters not monitored

Data/parameter	**>> $BCE_{i,v,s}$**
Description	>> Burning Consumption Efficiency for eligible fuel size class i, for eligible vegetation type v, in fire season s
Data unit	>> Proportion (%)
Equations referred	>> (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> The proportion of fuel volatised in a fire, also known as proportion of fuel consumed by fire (consumption). Burning efficiency is a function of seasonality, severity of fire and fuel size class. Values based on measurements as described for Australian savannas (Russell-Smith et al. 2009; Yates et al. 2015, 2023; Lynch et al. 2018), southern African miombo woodlands (Russell-Smith et al. 2024) , or similar when proponents develop and publish their own parameters
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> N/A

Data/parameter	**>> P_s**
Description	>> Patchiness for fire season s
Data unit	>> Proportion burned (%)
Equations referred	>> (8)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> The fire patchiness represents the fraction of overall fire-affected area (or burned area) that is actually burned and is a function of seasonality. EDS fires are characterised by a high degree of patchiness, while LDS fires are characterised by low levels of patchiness. Values based on measurements as described for Australian savannas (Russell-Smith et al. 2009; Yates et al. 2015, 2023; Lynch et al. 2018),

	southern African miombo woodlands (Russell-Smith et al. 2024) , or similar when proponents develop and publish their own parameters
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> $FL_{i,v,y,s}$**
Description	>> Fuel Load of eligible fuel size class i, from vegetation fuel type v, in year y, for fire season s
Data unit	>> Tonnes per hectare (t/ha)
Equations referred	>> (9), (10)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> The Fuel Load values for the load accumulated with the time elapsed since the vegetation was last burned. Values based on measurements as described for Australian savannas (Russell-Smith et al. 2009; Yates et al. 2015, 2023; Lynch et al. 2018), southern African miombo woodlands (Russell-Smith et al. 2024) , or similar when proponents develop and publish their own parameters
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> $FA_{YSLB,i,v,s}$**
Description	>> Fuel Accumulation value for years-since-last-burned value YSLB, for fuel size class i, for vegetation fuel type v, in fire season s
Data unit	>> Tonnes per hectare (t/ha)
Equations referred	>> (10)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> Fuel accumulation values derived from parameters including dead organic matter accumulation rate and decomposition rate for each fuel type. Values based on measurements as described in Australian savannas (Russell-Smith et al. 2009; Yates et al. 2015, 2023; Lynch et al. 2018), southern African miombo woodlands (Russell-Smith et al. 2024)

Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> $CC_{i,v,s}$**
Description	>> Carbon Content for eligible fuel size class i, for vegetation fuel type v, for fire season s
Data unit	>> Proportion (%)
Equations referred	>> (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> The carbon fraction of the relevant fuel size class and vegetation class, determined based on measurements as described in Australian savannas (Russell-Smith et al. 2009; Yates et al. 2015, 2023; Lynch et al. 2018), southern African miombo woodlands (Russell-Smith et al. 2024)
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> $EC_{g,i,v,s}$**
Description	>> Ratio to convert other elements to carbon, for greenhouse gas g, for fuel size class i, for vegetation fuel type v, for season s
Data unit	>> Dimensionless
Equations referred	>> (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> For CH_4, EC_{CH4} is the same for all vegetation fuel types v and fuel size classes i, and is equal to 1. For N_2O, $EC_{N2O,v}$ is the nitrogen to carbon ratio, for vegetation fuel type v, for eligible fuel size class i – see values provided in Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> Ratio to convert other elements to carbon, e.g. Nitrogen to Carbon ratio. Determined based on measurements as described in Australian savannas (Russell-Smith et al. 2009; Meyer et al. 2012), southern African miombo woodlands (Russell-Smith et al. 2024)
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> $EF_{g,i,v,s}$**
Description	>> Emission Factor for eligible greenhouse gas g, for eligible fuel size class i, for vegetation fuel type v, for fire season s
Data unit	>> Proportion (%)
Equations referred	>> (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> See Appendix 1, Section 2
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> The emission factor should be derived from direct field measurements from fires across the relevant geography. E.g. the emission factors for Australian Savannas are derived from Hurst et al. (1994), Meyer et al. (2012), Yates et al. (2023) While those used for Miombo regions follow Russell-Smith et al. (2021, 2024) and Vernooij et al. (2023)
Treatment of uncertainty	>> Values based on measurements as described in (Russell-Smith et al. 2009, Yates et al. 2015, Russell-Smith et al. 2024), or similar when proponents develop and publish their own parameters
Additional comments	>> NA

Data/parameter	**>> MtE_g**
Description	>> Ratio of molecular to elemental mass for greenhouse gas g
Data unit	>> Dimensionless
Equations referred	>> (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Value(s) applied	>> for CH_4=1.3333, and for N_2O=1.5714.
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	>> For CH_4: 16/12 = 1.3333 For N_2O: 44/(14*2) = 1.5714
Treatment of uncertainty	>> NA
Additional comments	>> NA

15. Data and parameters monitored

Data/parameter	**>> Vegetation Fuel Type Map**
Description	>> Vegetation Fuel Type Map of the project area
Data unit	>> Various, spatial layer

Equations referred	>> Appendix 2	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	>> The Vegetation Fuel Type Map must be updated at the start of every crediting period, or if major events occur, e.g. clearing events or other events that significantly affect the Vegetation Fuel Type Map.	
Measurement methods and procedures	>> Data remotely sensed for the project area using a dMRV system, and validated on ground where necessary. See Appendix 2	
Entity/person responsible for the measurement	>> The Activity participants are responsible for creation and validation of the Vegetation Fuel Type Map	
Measuring instrument(s)	*Type of instrument*	>> Satellite Imagery (e.g., Landsat), aerial imagery (e.g., drone LiDAR), laser scanning data, GIS software, dMRV systems, GPS (for waypoint collection), field survey equipment
	Accuracy class	>> Map must demonstrate 80% accuracy or greater
	Calibration requirements	>> Calibration data from land covered by the map must be collected independently of validation data. Validation involves using a number of independent waypoints
	Location	>> Project Area
QA/QC procedures	>> See Appendix 2. This includes using independent waypoints, ensuring at least 80% accuracy, and re-interpretation or re-classification if accuracy is below 80%.	
Treatment of uncertainty	>> refer to Appendix 2 and Appendix 3	
Additional comment	>> NA	

Data/parameter	**>> $FSA_{v,y,s}$**
Description	>> Fire Surface Area in the Historical Reference Period within boundary type b, for vegetation fuel type v, in year y, for fire season s
Data unit	>> Hectares (ha)
Equations referred	>> (3), (8)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Measurement and updating frequency	>> Monthly maps that are aggregated to seasonal maps. These maps are only created once per crediting period
Measurement methods and procedures	>> Calculated across all project areas and leakage belt (if leakage belt is required), for each Vegetation Fuel Type in each season. Spatial data where each map unit is burned (1) or unburned (0) on a month or seasonal time scale. Determined by following the guidelines provided in Appendix 2
Entity/person responsible for the measurement	>> Activity participants (implied, as they are responsible for project implementation and reporting)

<table>
<tr><td rowspan="4">Measuring instrument(s)</td><td>Type of instrument</td><td>>> Satellite Imagery (e.g., Landsat, MODIS) processed via GIS software or approved dMRV systems. Ground-based validation tools (GPS, visual assessment)</td></tr>
<tr><td>Accuracy class</td><td>>> Not explicitly stated as a class, but validation requires achieving an 80% accuracy for burnt area maps.</td></tr>
<tr><td>Calibration requirements</td><td>>> Validation procedures for burnt area maps described in Appendix 2. Requires comparison with independent waypoints.</td></tr>
<tr><td>Location</td><td>>> Project area and leakage belt</td></tr>
<tr><td>QA/QC procedures</td><td colspan="2">>> Validation and verification procedures as per Appendix 2, including conversion to vector format, assigning numerical codes, selecting assessment waypoints, waypoint buffers, and accuracy calculation.</td></tr>
<tr><td>Treatment of uncertainty</td><td colspan="2">>> refer to Appendix 2 and Appendix 3</td></tr>
<tr><td>Additional comment</td><td colspan="2">>> NA</td></tr>
</table>

<table>
<tr><td>Data/parameter</td><td colspan="2">>> $FSA_{v,y,s}$</td></tr>
<tr><td>Description</td><td colspan="2">>> Fire Surface Area in the Crediting Period within boundary type b, for vegetation fuel type v, in year y, for fire season s</td></tr>
<tr><td>Data unit</td><td colspan="2">>> Hectares (ha)</td></tr>
<tr><td>Equations referred</td><td colspan="2">>> (3), (8)</td></tr>
<tr><td>Purpose of data</td><td colspan="2">☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions</td></tr>
<tr><td>Measurement and updating frequency</td><td colspan="2">>> Monthly maps that are aggregated to seasonal maps.
These maps are revised each year of the Crediting Period</td></tr>
<tr><td>Measurement methods and procedures</td><td colspan="2">>> Calculated across all project areas and leakage belt (if leakage belt is required), for each Vegetation Fuel Type in each season.
Spatial data where each map unit is burned (1) or unburned (0) on a month or seasonal time scale.
Determined by following the guidelines provided in Appendix 2</td></tr>
<tr><td>Entity/person responsible for the measurement</td><td colspan="2">>> Activity participants (implied, as they are responsible for project implementation and reporting)</td></tr>
<tr><td rowspan="4">Measuring instrument(s)</td><td>Type of instrument</td><td>>> Satellite Imagery (e.g., Landsat, MODIS) processed via GIS software or approved dMRV systems. Ground-based validation tools (GPS, visual assessment)</td></tr>
<tr><td>Accuracy class</td><td>>> Not explicitly stated as a class, but validation requires achieving an 80% accuracy for burnt area maps.</td></tr>
<tr><td>Calibration requirements</td><td>>> Validation procedures for burnt area maps described in Appendix 2. Requires comparison with independent waypoints.</td></tr>
<tr><td>Location</td><td>>> Project area and leakage belt</td></tr>
<tr><td>QA/QC procedures</td><td colspan="2">>> Validation and verification procedures as per Appendix 2, including conversion to vector format, assigning numerical codes, selecting assessment waypoints, waypoint buffers, and accuracy calculation.</td></tr>
<tr><td>Treatment of uncertainty</td><td colspan="2">>> refer to Appendix 2 and Appendix 3</td></tr>
</table>

Additional comment	>> NA

Data/parameter	>>$A_{b,v}$	
Description	>> Total area in boundary type b covered by eligible vegetation fuel type v	
Data unit	>> Hectares (ha)	
Equations referred	>> (3)	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	>> The Vegetation Fuel Type Map must be updated at the start of every crediting period, or if major events occur, e.g. clearing events or other events that significantly affect the Vegetation Fuel Type Map	
Measurement methods and procedures	>> Data remotely sensed for the project area (and leakage belt, if required) using a dMRV system, and validated on ground where necessary. See Appendix 2	
Entity/person responsible for the measurement	>> Activity participants (implied, as they are responsible for project implementation and reporting)	
Measuring instrument(s)	*Type of instrument*	>> Satellite Imagery (e.g., Landsat, MODIS) processed via GIS software or approved dMRV systems. Ground-based validation tools (GPS, visual assessment)
	Accuracy class	>> Not explicitly stated as a class, but validation requires achieving an 80% accuracy for burnt area maps
	Calibration requirements	>> Calibration data must be collected independently of validation data. Validation uses independent waypoints
	Location	>> Project area and leakage belt (if required)
QA/QC procedures	>> Validation procedures described in Appendix 2, including converting to vector format, assigning numerical codes, selecting assessment waypoints, waypoint buffers, and accuracy calculation. Map must demonstrate 80% accuracy or greater	
Treatment of uncertainty	>> refer to Appendix 2 and Appendix 3	
Additional comment	>> NA	

Data/parameter	>> YSLB Map
Description	>> Years Since Last Burned Map
Data unit	>> Years, spatial layer
Equations referred	>> Appendix 2
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Measurement and updating frequency	>> To be created by aggregating monthly fire maps for each calendar year in the historical reference period and each calendar year for the project period.
Measurement methods and procedures	>> Data remotely sensed for the project area using a dMRV system, and validated on ground where necessary (see Appendix 2). YSLB map shows

	how many years have elapsed since each mapping unit was burned in the current calendar year.	
Entity/person responsible for the measurement	>> Activity participants (responsible for creation)	
Measuring instrument(s)	*Type of instrument*	>> GIS software, satellite imagery data (from monthly/seasonal burnt area maps), dMRV systems
	Accuracy class	>> Based on accuracy of underlying burnt area maps (80%).
	Calibration requirements	>> Based on validation of underlying burnt area maps
	Location	>> *Project Area and leakage belt (if required)*
QA/QC procedures	>> See Appendix 2. This ensures the correct assignment of YSLB values based on historical fire data	
Treatment of uncertainty	>> refer to Appendix 2 and Appendix 3	
Additional comment	>> NA	

Data/parameter	**>> FC_y**	
Description	>> Fuel consumption in year y	
Data unit	>> Litres	
Equations referred	>> (21)	
Purpose of data	☐ Baseline emissions ☒ Project emissions ☐ Leakage emissions	
Measurement and updating frequency	>> Measured for all project activities and collated annually	
Measurement methods and procedures	>> Data to be collected from operation records such as invoices, meters or other verifiable devices.	
Entity/person responsible for the measurement	>> Activity participants	
Measuring instrument(s)	*Type of instrument*	>> Vehicle meters and other verifiable devices used for fuel storage or combustion purposes
	Accuracy class	>> In line with manufacturer specifications
	Calibration requirements	>> In line with manufacturer specifications
	Location	>> *Project Area*
QA/QC procedures	>> Operation records must be kept including details such as date, location, operator, fuel levels before and after prescribed burns.	
Treatment of uncertainty	>> Often immaterial.	
Additional comment	>> NA	

Data/parameter	**>> EC_y**	
Description	>> Electricity consumption in year y	
Data unit	>> kWh	
Equations referred	>> (21)	
Purpose of data	☐ Baseline emissions ☒ Project emissions ☐ Leakage emissions	
Measurement and updating frequency	>> Measured for all project activities and collated annually	
Measurement methods and procedures	>> Data to be collected from operation records such as invoices, meters or other verifiable devices.	
Entity/person responsible for the measurement	>> Activity participants	
Measuring instrument(s)	*Type of instrument*	>> Meters and other verifiable devices used for project activities
	Accuracy class	>> In line with manufacturer specifications
	Calibration requirements	>> In line with manufacturer specifications
	Location	>> *Project Area*
QA/QC procedures	>> Operation records must be kept including details such as date, location, operator, consumption levels before and after prescribed burns.	
Treatment of uncertainty	>> Often immaterial.	
Additional comment	>> NA	

15.1. Frequency of submission of monitoring reports

49. For activities involving removals and for emission reduction activities with risks of reversals:

This methodology is not applicable to activities involving removals.

(a) The maximum permissible interval between the start date of the first crediting period and the submission of the first monitoring report is five years; and

(b) The maximum permissible interval between the submission of two consecutive monitoring reports after the first monitoring report is also five years.

16. Methodologies principles

16.1. Encouraging ambition over time

50. This methodology encourages ambition over time in line with para. 40–41 and para. 44 (continuous improvement) of the Methodologies Standard, which require that methodologies embed dynamic features ensuring that credited outcomes remain conservative and aligned with progressively higher ambition.

The proposed Savanna Fire Management (SFM) methodology embeds ambition through:

- **Downward adjustments to historical baselines**: Baseline emissions are calculated using a 10–15 year historical reference period (HRP) and are subject to an initial downward adjustment, with at least a 1% annual reduction thereafter. This aligns with Baseline Standard, paras. 59–60, 64–66, ensuring that baselines progressively decrease over time rather than remain static.
  The methodology also requires comparison of the downward-adjusted baseline with the conservative BAU baseline ex-ante (PDD) and ex-post (MR), and selection of the lower of the two, consistent with the Baseline Standard.
- **Dynamic monitoring requirements**: Key indicators such as burned area (BA), fire seasonality (EDS vs. LDS), patchiness, fuel load, and years-since-last-burn (YSLB) are tracked annually using Earth Observation (EO) data and validated field methods. This ensures the project continuously adjusts to ecological realities, preventing crediting inflation.
- **Adaptive fire management practices**: By requiring evidence-based prescribed burning strategies, the methodology builds in adaptive management cycles. Lessons from the Australian ACCU methodology demonstrate that iterative fire management not only sustains but progressively improves outcomes, creating long-term emissions reductions and ecological benefits.
- **Alignment with host country ambition**: In line with Baseline Standard para. 76, proponents must demonstrate that the downward adjusted baseline trajectory does not exceed the ambition embedded in the host country's NDC or LT-LEDS. This ensures that credited reductions are aligned with national decarbonization pathways, preventing lock-in of insufficient ambition.

The PDD shall disclose all factors and quantitative methods used to determine the initial and annual downward adjustments, and these shall be reviewed and updated at each crediting-period renewal.

16.2. Contributing to the equitable sharing of mitigation benefits between participating Parties

51. In accordance with paras. 31–33 of the Methodologies Standard, this methodology embeds provisions that ensure mitigation outcomes are fairly and equitably shared between participating Parties and are not concentrated in a way that undermines sustainable development. The following requirements apply:

(a) **Host Party authorization and NDC integration**: All activity participants must secure host Party authorization under Article 6.4, which confirms that credited mitigation outcomes are accounted for transparently in the host Party's NDC. This avoids unequal claims and ensures benefits are aligned with national climate strategies.

(b) Activity participants shall apply any DNA-specified conditions relating to equitable sharing, and shall estimate, report, and justify the mitigation benefits accruing to the host Party (including share of outcomes retained domestically and/or qualitative/quantitative contributions to the host Party's NDC and long-term strategies.). These benefits shall be presented in the PDD and updated in each MR. Application of the Article 6.4 Sustainable Development Tool indicators shall evidence that sharing tangibly supports host Party sustainable development

(c) **Transparent attribution of mitigation outcomes**: Mitigation outcomes are calculated using the standardized, conservative baseline and leakage procedures of this methodology (see Sections 10–12), ensuring that emission reductions are clearly attributable to the Article 6.4 activity and not overstated.

(d) **Equitable socio-economic co-benefits:**

- *Employment and livelihoods*: Projects are required to prioritize the engagement of Indigenous peoples and local communities, providing training and employment (e.g., as community fire rangers) in remote savanna regions where alternative livelihoods are limited.
- *Cultural fire knowledge*: The methodology explicitly recognizes and promotes the integration of traditional ecological knowledge in fire management, supporting Indigenous stewardship and enhancing intergenerational transfer of cultural practices.
- *Biodiversity outcomes*: By shifting fire regimes from LDS to EDS and promoting mosaic burning, the methodology safeguards habitats for threatened savanna fauna, including small mammals and fire-sensitive bird species. These biodiversity gains constitute non-carbon benefits that contribute to equitable outcomes.

Activity participants must document, at the Project Design Document (PDD) stage, how co-benefits are being realized in the specific host-country context. While evidence from the Australian and southern African experiences demonstrates clear biodiversity, employment, and cultural co-benefits, further socio-economic analysis at the national and local level will be required to substantiate the distributional impacts in each new geography where the methodology is applied.

Project participants must also at the PDD stage provide host-country specific socio-economic analyses to demonstrate that the expected co-benefits (employment, cultural fire knowledge integration, biodiversity outcomes) are realized in the national and local context. The evidence must include, at a minimum:

- Employment and livelihoods: quantitative or qualitative data on jobs created, training provided, or income generated for Indigenous peoples and local communities;
- Cultural integration: documentation of the role of traditional fire knowledge (e.g., agreements, FPIC records, local protocols);
- Biodiversity proxies: country-relevant indicators, such as habitat patchiness indices, monitoring of fire-sensitive fauna, or protected-area reporting;
- Distributional equity: analysis of how benefits are shared across genders, vulnerable groups, or marginalized communities, where data are available.

Where robust national datasets are not available, proponents must provide conservative baseline statements and commit to monitoring indicators during the first crediting period.

16.3. Encouraging broad participation

52. In accordance with paragraph 51 of the Methodologies Standard, this methodology is explicitly designed to enable broad geographic, institutional, and stakeholder participation. It does so by meeting three key requirements:

(a) Geographic inclusivity

- The methodology applies to all woody savannas within the global savanna envelope, provided they meet the applicability conditions (extended dry season ≥4–5 months; <10% MAR-W rainfall during dry season; eligible vegetation fuel types).
- Case studies from northern Australia, southern Africa, and South America demonstrate that the methodology’s design is scalable and adaptable across continents with similar ecological conditions. This ensures that both developed and developing country Parties can apply it without undue restrictions.

(b) Institutional and stakeholder accessibility

- By using a historical emissions baseline with standardized downward adjustment and conservative BAU screening, the methodology reduces

  methodological complexity while retaining environmental integrity. This makes it feasible for local governments, Indigenous organizations, and community-based NGOs, which may have limited technical or financial resources, to implement projects.
  - Monitoring relies primarily on publicly available earth observation datasets (e.g., MODIS, Sentinel-2, Landsat) and transparent QA/QC protocols. This lowers transaction costs and removes dependency on proprietary data systems, further expanding accessibility.
  - Activity participants are further encouraged to make templates, tools, and guidance openly available, and to translate key forms into locally accessible languages to enable wider participation.

(c) Financial participation and equity
  - The methodology enables access to international carbon markets under Article 6.4, creating revenue streams that directly support local employment, cultural fire knowledge integration, and biodiversity co-benefits.
  - This ensures that developing-country Parties, Indigenous communities, and small landholders—who are often excluded from more capital-intensive mitigation activities—can participate meaningfully and share equitably in the benefits.
  - Where projects claim distributional or biodiversity co-benefits in the PDD, the corresponding indicator(s) and data source(s) shall be listed in Section 15 (Data and parameters monitored) or in the monitoring plan annex, to enable verification without affecting issuance if data are non-material to ER quantification.
  - To encourage broad participation, the methodology shall be applicable to Indigenous and community proponents, and to small public entities, provided that tenure and authorization are documented.

16.4. Attributability of emission reductions or net removals to the Article 6.4 activity

53. In accordance with Appendix 1, Section 5 of the Baseline Standard and para. 31(b) of the Methodologies Standard, the methodology ensures that all quantified emission reductions are directly and solely attributable to the Savanna Fire Management (SFM) activity. Attribution is secured through three complementary measures:

(a) Clear spatial activity boundaries
  - Project boundaries are delineated using georeferenced polygons, restricted to eligible woody savanna vegetation fuel types.
  - Exclusions (grasslands, croplands, water bodies, urban areas) prevent misattribution of emissions to ineligible ecosystems.

(b) Robust leakage accounting
  - A Leakage Belt (LB) is defined, monitored, and reported alongside the project area to capture potential activity-shifting of LDS fires.
  - Where leakage emissions are detected, these are quantified and deducted from project results.
  - Positive leakage (e.g., spillover of EDS adoption beyond the boundary) is conservatively documented but not credited, ensuring attribution remains confined to the project area.

(c) Conservative baseline identification

- Baselines are constructed from a historical reference period (HRP, 10–15 years) with mandatory downward adjustment and a conservative BAU screen.
- This ensures that credited reductions represent the difference between what would have occurred in the absence of the project and the demonstrable impacts of project activities.
- By combining these elements, emission reductions are attributed exclusively to changes in fire management practices (transition from LDS → EDS burning), within the defined and monitored boundary. This prevents both over-crediting and double-attribution of reductions to external drivers (e.g., unrelated land-use change or national policy shifts).

16.5. Potential perverse incentives

54. In accordance with Appendix 1, Section 6 of the Baseline Standard, the methodology is designed to explicitly prevent the creation of perverse incentives that could undermine environmental integrity, inflate credited reductions, or encourage harmful practices. The following safeguards apply:

(a) No crediting for increased burning activity
- Emission reductions are credited only where LDS fire emissions demonstrably decrease relative to the downward-adjusted baseline.
- Any increase in burning frequency, extent, or intensity beyond historical reference levels results in higher project emissions and therefore reduces credited outcomes, ensuring there is no incentive to burn more.

(b) Neutral or positive leakage set conservatively to zero
- In line with the Leakage Standard, where leakage assessments demonstrate no net displacement or a net positive effect (e.g., spillover adoption of EDS burning outside the project boundary), leakage is conservatively set to zero.
- This avoids any incentive to manipulate fire patterns outside the boundary in order to increase credited reductions.

(c) Exclusion of land-use conversions or non-woody systems
- Projects are only eligible in woody savannas that meet the defined applicability conditions.
- Grassland burning, agricultural expansion, or conversion of natural ecosystems into project areas are explicitly excluded to prevent perverse incentives for land clearing or ecosystem degradation.

(d) Safeguards against opportunistic project siting
- Applicability conditions and conservative baseline setting ensure that projects cannot be preferentially located in unusually high-emissions savannas for the sole purpose of maximizing credits.
- The Historical Reference Period (HRP) and downward adjustment provisions require that baselines reflect long-term fire regimes, not short-term anomalies.
- Projects located in anomalously high-emissions years relative to the HRP must document that such anomalies are not exploited for baseline inflation (see Section 10 downward adjustment).

16.6. Rebound effects

55. In accordance with Appendix 1, Section 7 of the Baseline Standard, the methodology requires that rebound effects be considered and conservatively addressed. Rebound effects occur where an activity reduces emissions in one context but indirectly stimulates emissions in another (e.g., through shifts in production, land use, or consumption patterns). For Savanna Fire Management (SFM), rebound effects are assessed as follows:

(a) Absence of commodity displacement

- SFM does not generate displaceable commodities such as timber, agricultural products, or biofuels.
- The activity modifies fire regimes rather than creating or substituting outputs; thus, there is no market-driven driver for emissions leakage.

(b) No evidence of indirect fire intensification

- Shifting fires from the late dry season (LDS) to the early dry season (EDS) reduces fire intensity and frequency.
- There is no evidence from Australian or African case studies that reducing LDS fires leads to compensatory increases in burning elsewhere.

(c) Positive ecological and land-use spillovers

- Reduced fire severity improves grazing productivity, ecosystem resilience, and biodiversity outcomes (e.g., mosaic burning supports savanna bird and mammal populations).
- These positive spillover effects are conservatively documented but excluded from crediting, in line with PACM rules, ensuring that no perverse rebound is incentivized.

(d) To ensure methodological integrity, the following provisions apply:

- Any evidence of rebound effects (e.g., increased burning in neighbouring lands not attributable to LDS displacement already covered in leakage accounting) must be documented in monitoring reports.
- Where such effects are detected and material (materiality threshold defined in Section 12 (Leakage) or ≥5% of baseline emissions, whichever is lower), they must be conservatively discounted from credited reductions.

Appendix 1. Vegetation Fuel Type Definitions and Parameters

1. Vegetation Fuel Type Definitions

For each Savanna ecosystem, and within its applicable spatial and rainfall range, there may be any number of Vegetation Fuel Types for which abatement must be estimated. Additional Vegetation Fuel Types (in addition or replacement to the generic Vegetation Fuel Types listed below) may be required on a case-by-case basis and must be informed by peer reviewed literature.

Vegetation fuel types are defined by the dominant stratum and the grass type and its structural formation (canopy height and foliage projected cover; grass type). Characteristic descriptors are used as a guide to determine the correct classification. See Table 3 and Table 4 below.
The Project Description Document must include a similar table to Table 3 and Table 4 below, where proponents must clearly describe the defining characteristics, indicator species and typical substrates for each vegetation fuel type for which abatement estimates are made.

The mandatory elements include the structural formation (canopy height and projected foliage cover – either directly or through a demonstrated relationship with canopy cover) of the dominant stratum and the grass type. The dominance of grass species relative to the dominance of other grass species (where this leads to different emission factors), or a variably dominated grass mix, assists in classifying the vegetation fuel type. There is no requirement to assess the exact percentage grass cover to assign vegetation fuel types.

Projected foliage cover is applied to a stratum or plot rather than an individual crown, and includes branches and leaves. It is usually not directly measured in the field for the upper stratum, and can be measured by various line interception methods for ground layer vegetation. Projected foliage cover may be estimated by canopy cover with relationships between the two being dependent on various factors including season, species, and age of vegetation.

Table 3 Vegetation Fuel Type classification example for Australia (Lynch et al. 2015)

Vegetation fuel type code	Vegetation fuel type name	Dominant strata			Grasses	Characteristic descriptors		
		Strata	Canopy height	Foliage Projected Cover (canopy cover)		Canopy trees	Shrubs	Substrates
OFMi	Open forest with mixed grasses	Canopy Trees	Majority of trees [>15 m]	[>30%] (>50%)	Dominated by native perennial and annual grasses	[TBD]	[TBD]	[TBD]
WMi	Woodland with mixed grasses	Canopy Trees	Majority of trees [>10m]	[10-30%] (>20%)	Dominated by native perennial and annual grasses;	[TBD]	[TBD]	[TBD]
OWMi	Open Woodland with mixed grasses	Canopy Trees	Majority of trees [<10 m]	[<10%] (<20%)	Dominated by native perennial	[TBD]	[TBD]	[TBD]

Vegetation fuel type code	Vegetation fuel type name	Dominant strata			Grasses	Characteristic descriptors		
		Strata	Canopy height	Foliage Projected Cover (canopy cover)		Canopy trees	Shrubs	Substrates
					and annual grasses;			
[OTH]	[Other, e.g. shrubland with mixed grasses]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]
Ineligible	Ineligible forest and non-savanna ecosystems (grasslands, riparian, wetlands etc.)	[various]	[various]	[various]	n/a	[TBD]	[TBD]	[TBD]

Table 4 Example vegetation fuel type classification tables from the Australian SFM method (SFM 2015) for (a) the high (>1000mm MAR) and (b) the low (600-1000mm MAR) rainfall zone savannas in northern Australia.

(a)

Vegetation fuel type code	Vegetation fuel type name	Dominant strata			*Grasses*	Characteristic descriptors		
		Strata	Canopy height	Foliage Projected cover		*Canopy trees*	*Shrubs*	*Substrates*
hOFM	Open forest with mixed grasses	Canopy Trees	Majority of trees >15 m	30-70 %	Dominated by native perennial and annual tussock grasses	Various *Eucalyptus* and *Corymbia* species (for example, *E. tetrodonta, E. miniata, C. nesophila, C. stockeri*)	Various species—well developed shrub layer may/may not be present	Well drained deep soils, often sandy loams
hWMi	Woodland with mixed grasses	Canopy Trees	Majority of trees >8 m	10-30 %	Dominated by native perennial and annual tussock grasses; may be associated with hummock grasses (*Triodia* species)	Various *Eucalyptus* (for example, *E. tetrodonta*) and *Corymbia* spp, often with other taxa (for example, *Erythrophleum, Terminalia, Callitris*). May contain *Melaleuca*. spp.	Various species—well developed shrub layer may/may not be present	Various situations, from well-drained gravelly sites to those with impeded drainage
hWHu	Woodland with hummock grasses	Canopy Trees	Majority of trees >8 m	10-30 %	Dominated by hummock (*Triodia*) grasses. A mixture of native perennial and annual tussock grasses may also be present	Various *Eucalyptus* and *Corymbia* often with other taxa (for example, *Erythrophleum, Terminalia, Xanthostemon*) May contain *Melaleuca*. spp.	Various species—well developed shrub layer may or may not be present. Where present, may include woody heath taxa as listed for hSHH	Rocky shallow soils derived typically from sandstone (quartzite); also lateritic hills and plateau
hSHH	Shrubland (heath) with hummock grasses	Shrubs	Majority of shrubs <5 m	0-30 %	The presence of hummock (*Triodia*) grasses, or other perennial members of the *Restionaceae* (*Lepyrodia, Dapsilanthus*), or sedges (*Schoenus sparteus*) or graminoids (for example, *Lomandra, Xanthorrhoea*)	Sparse trees	Conspicuous cover of heathy shrubs (for example, *Acacia, Calytrix, Grevillea, Hibbertia, Hibiscus, Jacksonia, Tephrosia, Verticordia*)	Shallow to rocky substrates derived typically from sandstone, metamorphosed sandstone (for example, quartzite), sometimes laterised; sand sheets

(b)

Vegetation fuel type code	Vegetation fuel type name	Dominant strata			Grasses	Characteristic descriptors		
		Strata	Canopy height	Foliage projected cover		*Canopy trees*	*Shrubs*	*Substrates*
lWTu	Woodland with tussock grass	Canopy Trees	Majority of trees >10 m	10-30 %	Native perennial and annual tussock grasses	Various *Eucalyptus* (for example, *E. tectifica,*) and *Corymbia* (for example, *C. opaca*) often with other taxa (for example, *Erythrophleum, Terminalia*)	Well developed shrub layer may/not be present.	Majority deep well drained soils to those with impeded drainage, typically on flat to undulating landtypes with fertile volcanic-derived substrates
lWMi	Woodland with mixed tussock / hummock grass	Canopy Trees	Majority of trees >10 m	10-30 %	Native perennial and annual tussock grass, may be associated with hummock (*Triodia*) grasses	Various *Eucalyptus* (for example, *E. tetrodonta*) and *Corymbia* spp, often with other taxa (for example, *Erythrophleum, Terminalia, Callitris*)	Well developed shrub layer may/may not be present.	Various situations including undulating to hilly landtypes on imperfectly to well drained soils
lWHu	Woodland with hummock grasses	Canopy Trees	Majority of trees >10 m	10-30 %	Hummock (*Triodia*) grasses usually dominant, tussock grasses may also occur	Various *Eucalyptus* and *Corymbia* often with other taxa (for example. *Erythrophleum, Terminalia, Xanthostemon*)	Well developed shrub layer may/may not be present; may include woody heath taxa	Rocky shallow soils derived typically from sandstone (quartzite); also lateritic hills and plateau
lOWM	Open woodland with mixed grass	Canopy Trees	Majority of trees <10 m	<10 %	Hummock (*Triodia*) grasses often dominant, or codominant with tussock grasses	Various *Eucalyptus* and *Corymbia*, including *C.dichromophloia, E.leucophloia, E. brevifolia, E.pruinosa, E.tectifica*	Well developed shrub layer may/may not be present. Where present, may include woody heath taxa	Shallow substrates on undulating stony rises and rocky hills
lSHH	Shrubland with hummock grass	Shrubs	Majority of shrubs <5 m	<30 %	Hummock (*Triodia*) grass, and/or other perennial restios (*Lepyrodia, Dapsilanthus*) sedges (*Schoenus sparteus*) or graminoids (for example, *Lomandra, Xanthorrhoea*)	Sparse trees	Conspicuous shrub (heath) layer, commonly *Acacia* species and various other taxa (for example, *Calytrix, Grevillea, Hibbertia, Hibiscus, Jacksonia, Tephrosia, Veritcordia*)	Sand plains often over laterite, or rocky, shallow substrates derived from sandstone

2. Fixed Parameter Reference Values

Parameters that exist for specific regions are listed here, including those for the Southern African Miombo region, and for northern Australia. For applicable regions where such data is not yet available, the suggested methods and procedures to be followed to obtain these values are explained in Section 3 of this appendix.

2.1. Miombo Region

Data from open woodland (OWDL) with <20% cover and woodland (WDL) with >20% cover areas from “Wet” (>1000mm MAR) and “Dry” (<1000mm MAR) Miombo regions are provided below (Table 4 in Russell-Smith et al. 2024). MAR data was sourced from the ERA5-Land dataset of the Copernicus Climate Change Service. Note: for OWDL in high rainfall areas, it is considered conservative to use the low rainfall OWDL parameters.

Parameters and variables	600-1000mm MAR				>1000mm MAR		Notes
	OWDL		WDL		WDL		
(a) Fuel Load/ Accumulation (t ha^{-1})							
• Fine Fuels	EDS	LDS	EDS	LDS	EDS	LDS	Significant linear relationships of natural log-transformed data—refer to Fig. 4 in Russell-Smith et al. 2024.
1 year since last fire	2.27	2.56	2.16	2.40	2.42	2.75	Seasonal litter contributions adjusted for

Parameters and variables	600-1000mm MAR				>1000mm MAR		Notes
	OWDL		WDL		WDL		
2 years	2.63	2.97	2.50	2.78	2.75	3.14	by difference in the proportions of litter:fine fuels determined respectively from EDS and LDS field samples—refer Methods section in Russell-Smith et al. 2024.
3 years	2.87	3.24	2.72	3.02	2.97	3.39	
4 years	3.05	3.45	2.88	3.21	3.14	3.57	
5 Years	3.20	3.61	3.02	3.36	3.27	3.73	
6+ Years	3.33	3.76	3.14	3.50	3.38	3.86	
• Shrub fuels							Significant linear relationships of natural log-transformed data for WDL classes—refer to Fig. 4 in Russell-Smith et al. 2024.
1 year since last fire	3.37		1.58		1.14		
2 years	3.37		2.25		1.83		
3 years	3.37		2.77		2.42		
4 years	3.37		3.21		2.95		
5 Years	3.37		3.60		3.44		
6+ Years	3.37		3.95		3.89		
• Coarse woody debris	0.55		0.52		0.39		No significant linear relationships—refer to Fig. 4 in Russell-Smith et al. 2024.
• Heavy woody fuels	0.91		0.99		1.60		No significant linear relationships—refer to Fig. 4 in Russell-Smith et al. 2024.
(b)Burning Efficiency/ Consumption (%)							
Early dry season							
• Fine fuels	65.94		59.82		59.82		Combining WDL observations given apparently anomalous mean and low n.
• Shrubs	4.90		5.42		5.42		Combining WDL observations given low n.
• Coarse woody debris	10.18		5.77		5.77		Combining WDL observations given apparently anomalous mean and low n.
• Heavy woody fuels	1.05		0.51		0.51		Combining WDL observations given apparently anomalous mean and low n.
Late dry season							
• Fine fuels	76.42		70.00		73.04		
• Shrubs	9.33		18.90		13.76		
• Coarse woody debris	19.23		21.18		8.65		
• Heavy woody fuels	23.33		8.73		10.37		
(c) Burned Patchiness (%)							

Parameters and variables	600-1000mm MAR		>1000mm MAR	Notes
	OWDL	WDL	WDL	
Early dry season	67.54	64.42	64.62	Combining WDL observations given apparently anomalous mean and low n.
Late dry season	81.89	94.28	96.32	
(d) C and N content				
Early dry season				Refer Russell-Smith et al. 2021
• Fuel C content (%)	49.01	43.48	45.43	
• Fuel N:C ratio	0.02	0.015	0.014	
Late dry season				
• Fuel C content (%)	48.59	46.44	46.28	
• Fuel N:C ratio	0.02	0.02	0.012	
(e) Emission Factors (%)				
Early dry season				Refer Vernooij et al. 2023.
• CH_4 (%C)	0.19	0.25	0.26	
• N_2O (%N)	0.60	0.45	0.43	
Late dry season				
• CH_4 (%C)	0.18	0.31	0.35	
• N_2O (%N)	0.70	0.45	0.54	

2.2. Australian Savannas

Data for Australian Savannas is provided below. The high rainfall zone covers the Australian wet tropics with >1,000mm MAR, and the low rainfall zone covers the drier tropics with 600-1,000mm MAR.

These parameters are extracted from the Australian Savanna Fire Management Methodology 2015 (SFM 2015), except for Pindan (acacia shrubland) parameters, which were sourced from Lynch et al. 2018: Table 1.

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
Fuel Load / Accumulation (t ha-1)					
EDS	Fine Fuels	hOFM (Open forest with mixed grass)	1	2.74	
			2	4.25	
			3	5.07	
			4	5.53	
			5	5.78	
			6+	6.06	
		l/hWMi (Woodland with mixed grass)	1	3.8	2
			2	4.41	2.69
			3	4.51	2.89
			4	4.53	2.95
			5	4.53	2.97
			6+	4.53	2.98

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
		I/hWHu (Woodland with hummock grass)	1	2.08	1.75
			2	3.41	3.14
			3	4.25	4.12
			4	4.79	4.8
			5	5.14	5.27
			6+	5.68	5.6
		I/hSHH (Shrubland (heath) with hummock grass)	1	1.88	1
			2	3.55	2.11
			3	5.03	3.08
			4	6.35	3.93
			5	7.51	4.68
			6+	11.64	5.32
		IWTu (Woodland with tussock grass)	1		2.71
			2		4.48
			3		5.52
			4		6.12
			5		6.47
			6+		6.68
		IOWM (Open woodland with mixed grass)	1		2.79
			2		3.66
			3		3.91
			4		3.98
			5		4.01
			6+		4.01
		Pindan (Acacia shrubland)	1		2.27
			2		3.17
			3		3.85
			4		4.41
			5		4.91
			6		5.36
			7		5.77
			8		6.15
			9		6.50
			10+		6.84
LDS	Fine Fuels	hOFM (Open forest with mixed grass)	1	4.44	
			2	5.95	
			3	6.77	
			4	7.23	
			5	7.48	
			6+	7.76	
			1	5.5	2.28
			2	6.11	2.97

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
		I/hWMi (Woodland with mixed grass)	3	6.21	3.17
			4	6.23	3.23
			5	6.23	3.25
			6+	6.23	3.26
		I/hWHu (Woodland with hummock grass)	1	3.78	2.01
			2	5.11	3.4
			3	5.95	4.38
			4	6.49	5.06
			5	6.84	5.53
			6+	7.38	5.86
		I/hSHH (Shrubland (heath) with hummock grass)	1	3.58	1.28
			2	5.25	2.39
			3	6.73	3.36
			4	8.05	4.21
			5	9.21	4.96
			6+	13.34	5.6
		IWTu (Woodland with tussock grass)	1		3.05
			2		4.82
			3		5.86
			4		6.46
			5		6.81
			6+		7.02
		IOWM (Open woodland with mixed grass)	1		2.97
			2		3.84
			3		4.09
			4		4.16
			5		4.19
			6+		4.19
		Pindan (Acacia shrubland)	1		2.27
			2		3.17
			3		3.85
			4		4.41
			5		4.91
			6		5.36
			7		5.77
			8		6.15
			9		6.50
			10+		6.84
No seasonal change	Shrub	hOFM (Open forest with mixed		1.5	
		I/hWMi (Woodland with mixed		0.5	0.66
		I/hWHu (Woodland with		1.7	1.84
		I/hSHH (Shrubland (heath) with		1.8	0.87

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
		IWTu (Woodland with tussock			0.27
		IOWM (Open woodland with			1.13
		Pindan (Acacia shrubland)			4.29
	Coarse	hOFM (Open forest with mixed		1.4	
		l/hWMi (Woodland with mixed		0.9	0.69
		l/hWHu (Woodland with		1.2	1.85
		l/hSHH (Shrubland (heath) with		0.6	0.73
		IWTu (Woodland with tussock			1.39
		IOWM (Open woodland with			0.76
		Pindan (Acacia shrubland)			1.28
	Heavy	hOFM (Open forest with mixed		4.8	
		l/hWMi (Woodland with mixed		2.2	2.02
		l/hWHu (Woodland with		3.4	1.15
		l/hSHH (Shrubland (heath) with		1.7	0.17
		IWTu (Woodland with tussock			1.25
		IOWM (Open woodland with			0.8
		Pindan (Acacia shrubland)			1.17
Burning Efficiency / Consumption (%)					
EDS	Fine	All excluding Pindan (Acacia shrubland)		74.44	79.92
	Coars			14.64	10.90
	Heavy			17.08	6.65
	Shrub			28.96	9.82
LDS	Fine			86.04	83.28
	Coars			35.71	20.16
	Heavy			30.93	11.92
	Shrub			39.34	10.98
EDS	Fine	Pindan (Acacia shrubland)			77.7
	Coars				22.6
	Heavy				11.7
	Shrub				7.6
LDS	Fine				82.5
	Coars				32.8
	Heavy				10.7
	Shrub				11
Burned Patchiness (%)					
EDS	All	All excluding Pindan (Acacia shrubland)		71	79
LDS	All			89	97
EDS	All	Pindan (Acacia shrubland)			76.9
LDS	All				89.2
Carbon Content (%)					
	Fine	hOFM (Open forest with mixed		46	
		l/hWMi (Woodland with mixed		46	39.7

Season	Fuel type	Vegetation type YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
No seasonal change		I/hWHu (Woodland with hummock grass)	46	39.7
		I/hSHH (Shrubland (heath) with hummock grass)	46	39.8
		IWTu (Woodland with tussock		41
		IOWM (Open woodland with mixed grass)		39.9
		Pindan (Acacia shrubland)		39.8
	Shrub	hOFM (Open forest with mixed	46	
		I/hWMi (Woodland with mixed	46	48.5
		I/hWHu (Woodland with hummock grass)	46	48.5
		I/hSHH (Shrubland (heath) with hummock grass)	46	48.5
		IWTu (Woodland with tussock		48.5
		IOWM (Open woodland with mixed grass)		48.5
		Pindan (Acacia shrubland)		48.5
	Coarse	hOFM (Open forest with mixed	46	
		I/hWMi (Woodland with mixed	46	48.5
		I/hWHu (Woodland with hummock grass)	46	48.5
		I/hSHH (Shrubland (heath) with hummock grass)	46	48.5
		IWTu (Woodland with tussock		48.5
		IOWM (Open woodland with mixed grass)		48.5
		Pindan (Acacia shrubland)		48.5
	Heavy	hOFM (Open forest with mixed	46	
		I/hWMi (Woodland with mixed	46	48.5
		I/hWHu (Woodland with hummock grass)	46	48.5
		I/hSHH (Shrubland (heath) with hummock grass)	46	48.5
		IWTu (Woodland with tussock		48.5
		IOWM (Open woodland with mixed grass)		48.5
		Pindan (Acacia shrubland)		48.5
Nitrogen to Carbon Ratio (N:C)				
No seasonal change	Fine	hOFM (Open forest with mixed	0.0096	
		I/hWMi (Woodland with mixed	0.0096	0.0118
		I/hWHu (Woodland with	0.0096	0.0113
		I/hSHH (Shrubland (heath) with	0.0096	0.0107

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
		lWTu (Woodland with tussock			0.0105
		lOWM (Open woodland with			0.0102
		Pindan (Acacia shrubland)			0.0107
	Shrub	hOFM (Open forest with mixed		0.0093	
		l/hWMi (Woodland with mixed		0.0093	0.00389
		l/hWHu (Woodland with		0.0093	0.00389
		l/hSHH (Shrubland (heath) with		0.0093	0.00389
		lWTu (Woodland with tussock			0.00389
		lOWM (Open woodland with			0.00389
		Pindan (Acacia shrubland)			0.00389
	Coarse	hOFM (Open forest with mixed		0.0081	
		l/hWMi (Woodland with mixed		0.0081	0.00389
		l/hWHu (Woodland with		0.0081	0.00389
		l/hSHH (Shrubland (heath) with		0.0081	0.00389
		lWTu (Woodland with tussock			0.00389
		lOWM (Open woodland with			0.00389
		Pindan (Acacia shrubland)			0.00389
	Heavy	hOFM (Open forest with mixed		0.0081	
		l/hWMi (Woodland with mixed		0.0081	0.01497
		l/hWHu (Woodland with		0.0081	0.01497
		l/hSHH (Shrubland (heath) with		0.0081	0.01497
		lWTu (Woodland with tussock			0.01497
		lOWM (Open woodland with			0.01497
		Pindan (Acacia shrubland)			0.01497
Emissions Factors (Methane CH_4, %)					
No seasonal change	Fine	hOFM (Open forest with mixed		0.31	
		l/hWMi (Woodland with mixed		0.31	0.17
		l/hWHu (Woodland with		0.31	0.15
		l/hSHH (Shrubland (heath) with		0.15	0.13
		lWTu (Woodland with tussock			0.16
		lOWM (Open woodland with			0.12
		Pindan (Acacia shrublands)			0.15
	Shrub	hOFM (Open forest with mixed		0.31	
		l/hWMi (Woodland with mixed		0.31	0.17
		l/hWHu (Woodland with		0.31	0.15
		l/hSHH (Shrubland (heath) with		0.15	0.13
		lWTu (Woodland with tussock			0.16
		lOWM (Open woodland with			0.12
		Pindan (Acacia shrubland)			0.15
	Coarse	hOFM (Open forest with mixed		0.31	
		l/hWMi (Woodland with mixed		0.31	0.17
		l/hWHu (Woodland with		0.31	0.15

Season	Fuel type	Vegetation type	YSLB	High rainfall (>1,000mm MAR)	Low rainfall (600 - 1,000mm MAR)
		l/hSHH (Shrubland (heath) with		0.15	0.13
		lWTu (Woodland with tussock			0.16
		lOWM (Open woodland with			0.12
		Pindan (Acacia shrubland)			0.15
	Heavy	hOFM (Open forest with mixed		1	
		l/hWMi (Woodland with mixed		1	1.58
		l/hWHu (Woodland with		1	1.58
		l/hSHH (Shrubland (heath) with		1	1.11
		lWTu (Woodland with tussock			1.58
		lOWM (Open woodland with			1.11
		Pindan (Acacia shrubland)			1.58
Emissions Factors (Nitrous Oxide N_2O, %)					
No seasonal change	Fine	hOFM (Open forest with mixed		0.75	
		l/hWMi (Woodland with mixed		0.75	0.6
		l/hWHu (Woodland with		0.75	0.6
		l/hSHH (Shrubland (heath) with		0.66	0.59
		lWTu (Woodland with tussock			1.2
		lOWM (Open woodland with			0.6
		Pindan (Acacia shrubland)			0.6
	Shrub	hOFM (Open forest with mixed		0.75	
		l/hWMi (Woodland with mixed		0.75	0.6
		l/hWHu (Woodland with		0.75	0.6
		l/hSHH (Shrubland (heath) with		0.66	0.59
		lWTu (Woodland with tussock			1.2
		lOWM (Open woodland with			0.6
		Pindan (Acacia shrubland)			0.6
	Coarse	hOFM (Open forest with mixed		0.75	
		l/hWMi (Woodland with mixed		0.75	0.6
		l/hWHu (Woodland with		0.75	0.6
		l/hSHH (Shrubland (heath) with		0.66	0.59
		lWTu (Woodland with tussock			1.2
		lOWM (Open woodland with			0.6
		Pindan (Acacia shrubland)			0.6
	Heavy	hOFM (Open forest with mixed		0.36	
		l/hWMi (Woodland with mixed		0.36	1.46
		l/hWHu (Woodland with		0.36	1.46
		l/hSHH (Shrubland (heath) with		0.36	1.46
		lWTu (Woodland with tussock			1.46
		lOWM (Open woodland with			1.46
		Pindan (Acacia shrubland)			1.46

3. Protocol to Derive New Parameters for Applicable Savannas

This protocol provides a method to measure prescribed parameters required for use in the SFM method. The parameters are used to estimate greenhouse gas (GHG) emissions resulting from prescribed burning and other fires in fire-prone savanna landscapes.

This appendix is designed to support emissions reduction projects in non-Miombo and non-Australian applicable savannas, where the required prescribed parameters do not yet exist. This is achieved by enabling robust, repeatable measurements of emissions from fire, based on field-measured fuel loads, fire characteristics, and post-burn sampling and calculating a set of standard parameters for particular eligible vegetation types in a particular eligible region, as per the applicability conditions of Section 5.

If this appendix is being used in the context of an emission reduction project involving savanna burning or prescribed fire regimes, it supports calculation of net emissions and emission reductions across different fire seasons and fire management strategies.

Data must be collected consistently for each transect and targeted fire event. All field, laboratory, and remote sensing data should be quality controlled and stored in line with the monitoring plan. The following gear is generally required for field assessments: GPS, 100m tape, compass, clinometer, metre sticks, scales, buckets, bags, and data sheets.

3.1. Applicability Conditions

This appendix is applicable to fire-prone woody savanna regions - other than those listed in Section 2 of this appendix - which meet the eligibility requirements of the SFM method, and where prescribed burning is implemented or will be implemented for emissions reduction and land management purposes namely:

- Areas and regions that meet applicability criteria according to the SFM method but are not Miombo or Northern Australia savannas.

3.2. Overarching Requirements

All parameters must be derived from peer-reviewed studies, official methodologies or from scientifically robust field data. These parameters must be publicly available or published in reputable sources. If unpublished, a full technical appendix detailing methods and raw data must be provided in the Project Design Document (PDD).

Where projects apply this protocol, the following must be included within the PDD at Validation stage:

- All parameters must be explicitly included, with clear values and units of measurement, as per the tables in Section 2 of this appendix,
- All sources must be cited,
- If applicable, a full technical appendix detailing methods and raw data, and
- A justification explaining how the parameters meet the applicability conditions and requirements of this protocol. This includes demonstrating their appropriateness for the specific vegetation fuel type and fire regime, and alignment with protocol requirements, such as conservative assumptions and empirical derivation.

3.3. Measured Parameters

The following parameters must be calculated for the relevant eligible regions that do not yet have these parameters defined.

Once calculated, these parameters must be presented in a format that matches Section 2 of this appendix and included with the PDD for validation, as outlined in Section 3.2 above.

Care must be taken to identify eligible woody savanna vegetation types that will benefit from fire management, and exclude savannas where Early Dry Season burning could have a detrimental ecological impact (e.g. woody thickening in grasslands). As per Section 1 of this appendix, these are defined by the dominant vegetation stratum and grass type as well as the structural formation where necessary (e.g. open forest with mixed grass, woodland with mixed grass, woodland with hummock grass, etc., from the Australian parameters (see Section 1 of this appendix)).

Proponents using this protocol must define appropriate vegetation fuel type categories for their area using guidance from peer reviewed literature from the region, such that each category is expected to burn and respond to fire in a similar way. Thresholds to differentiate between the major vegetation types must be incorporated into field sampling protocols to assess field plots where necessary (e.g. canopy cover index used to differentiate between woodland and open woodland vegetation fuel types in Russel-Smith et. al 2024).

Each of the vegetation fuel types must be measured in a low rainfall and high rainfall setting, if there is expected to be a difference in burning behaviour and or response to fire above or below particular rainfall thresholds. Plants within each of these vegetation fuel type categories are then classed by size into each of the vegetation fuel size classes (see Section 3 for definitions of fine, shrub, coarse and heavy).

Once vegetation has been stratified, representative sampling is to be carried out through the establishment of permanent transects in each vegetation fuel type. This should include at least three fully replicated transects in each vegetation fuel type and for each targeted fuel age, spaced at least 100 m apart from each other (Russell-Smith et al. 2021; 2024).

The below descriptions are provided for 100x10m transects with examples of how quadrats and sub-sampling areas can be set up along the left hand side (LHS) and right hand side (RHS) of this marked line to collect data for emissions parameters. Should 100x10m transects not be practically possible, alternative sampling areas such as 50x10 m transects with higher replication could be considered. Date, coordinates, place name, and time since last burn should be documented for each transect. Transects are sampled pre- and post- fires. The pre-fire sampling focuses on measuring the weight of each size class within each vegetation fuel type and the nitrogen to carbon ratio and carbon content of each of these, while the post fire sampling determines burning efficiency, burned patchiness, and carbon and nitrogen contents of burned fuel. Sampling for emissions factors (CH_4 and N_20) requires drone-based sampling of smoke during the EDS or LDS burns. To collect all required data, fire treatments should be undertaken under EDS and LDS conditions. Perimeter spot-ignition prescribed burns incorporating both fronting fires and backburns should be undertaken during EDS conditions with benign fire-climate conditions. LDS treatments should be undertaken similarly, but under midday high-temperature and typical fire-weather conditions. LDS fire treatments need to be planned carefully to ensure that fire treatments will be effectively contained.

3.3.1. Pre-fire Fuel Load Accumulation (by vegetation fuel size class, $t.ha^{-1}$)

Transects are to be placed in vegetation with equivalent fuel age. Fuel age is to be determined based on satellite-derived time-since-fire, or appropriate local field data.

Fine ground fuels, including grass and litter, are sampled and weighed separately from five 1 x 1 m quadrats at 20 m intervals on the LHS of the transect. A composite sub-sample from the three quadrats is then taken, weighed, and later oven-dried to determine dry weight.

Coarse ground fuels, defined as material with a diameter ≥ 6 mm and < 5 cm, are fully collected and weighed from three 5 x 5m quadrats at 50 m intervals on the LHS of the transect. A bulked sub-sample from the three quadrats is also taken from this material and subsequently dry weighed (Russell-Smith et al., 2021).

The volume of dead heavy woody fuels (HWF) should be estimated using a prepared pro forma along a 5 x 100 m belt transect. Measurements of length, diameter and hollowness can be combined with an estimated density constant (such as 0.61 g.cm-3 from Russel-Smith et al. 2024 following Handavu et al. 2021). In that example, dead stems >5 m diameter were counted in length ranges of 0-50cm, 51 cm -1 m, 1-2 m, 2-3 m,3-4 m and 4-5 m. If tree lengths exceeded 5 m, sampling was undertaken in sections of the tree. Dead steam diameters were recorded in 5 cm incremental categories from 5 cm to >50 cm. Dead stem solid volume was estimated in four classes, 90-100%, 75-90 %, 50-75% and <50%.

Shrub (<5cm DBH) biomass should be estimated within five, 1 m of the RHS of the transect. For each dominant shrub species and size class height classes: <50 cm, 50cm -1m, 1-2 m, >2m, three individual samples are to be cut and weighed (above ground leaves and stems only). Sub-samples from these are then taken for drying and weighed once dry. Mean aboveground dry biomass should be calculated for sub-samples.

Fuel accumulation relationships are established with simple linear regressions (with natural log transforms of both variables) between time since last burn and weights of each vegetation fuel size class. This must be repeated for each vegetation fuel type. In the absence of significant relationships (P <0.05), mean loads for each time since last burn category can be applied.

3.3.2. Pre-fire Carbon Content (%)

For each fire event, representative fuel samples must be oven-dried and analysed for percentage carbon by weight. These values are used to convert dry fuel mass into fuel carbon mass for use in emission calculations (Russell-Smith et al, 2024).

3.3.3. Pre-fire Structural Vegetation Measurements

In addition to the above fuel load and emissions related measures, quantitative metrics of vegetation size are also required along the same 100 m transects.

Ground Cover: Measured along the RHS of the transect within five, 20x1 m sub-sections, ground covers should be classified as: %rock, % bare ground, % perennial graminoid cover, % annual grass cover, % shrub cover of woody species <5cm DBH. Where feasible, drone-based assessments with a multi-spectral camera may be used, with adjusted categories such as bare soil, foliage, grass, woody material or shadow. (e.g. Russell-Smith et al. (2021)).

Shrub species & heights: Within 1m of the transect on the RHS, count and identify dominant woody species <5cm DBH in the following height classes: <50 cm, 50cm -1m, 1-2 m, >2m.

Tree canopy cover: measured in a 1x 1 m quadrat every 5 m, using the following categories: no cover, <50% cover, >50% cover.

Tree (>5cm at DBH) basal area (m2ha-1): Count, Identify and permanently tag all living and dead stems on 5 m either side of the transect. Measure their DBH, height in the following height classes (using clinometer or laser range-finder): <50 cm, 50cm -1m, 1-2 m, >2m, and health status from healthy to dead in the following categories: 1: healthy, 2: reasonable (some dead branches and fire scar), 3: poor (deep fire scars and many dead branches), 4: very poor (nearly dead), and

5: dead. Basal area should be calculated subsequently for all living and dead stems in the transect.

3.3.4. Pre- and Post-fire Nitrogen to Carbon Ration (N:C)

Before each fire event, vegetation samples from various fuel types should be sampled, their carbon and nitrogen contents measured, and the weighted average carbon and nitrogen contents for burned mixed fuel calculated. Nitrogen content, along with carbon content, needs to be measured in the lab from field samples to support EF calculation. EF for N_2O is derived by dividing the N_2O ER by the molar-weighted average N:C ratio in the burned fuel using the equation below (Russell-Smith et al., 2024):

$$\mathrm{EF_{N2O}} = \frac{ER_{N2O}}{NC_{molar}} \times 100\% \qquad (26)27$$

where:

ER_{N20} = Molar amount of N_2O emitted
NC_{molar} = Molar amount of nitrogen input

3.3.5. During-fire Emission Factors (CH_4 (%C), N_2O (%N))

Emissions should be sampled using drone-mounted Tedlar bags and mast-based cavity ring-down spectroscopy (CRDS) during prescribed EDS and LDS burns (Russell-Smith et al., 2024; Vernooij et al., 2022). Carbon and nitrogen content are supported by (EF) calculations using the carbon mass balance approach (Vernooij et al., 2022):

$$EF_i = F_c \times \frac{MW_i}{AM_c} \times \frac{C_i}{C_{total}} \qquad (28)$$

Where:

F = Carbon fraction of fuel combusted
MW_i = Molecular weight of compound i
AM_c = Atomic mass of carbon
C_i = Carbo emitted as compound i
C_{itotal} = Total carbon emitted

3.3.6. Post-fire Burning Efficiency (%) (also called fuel consumption)

Post-fire fuel component consumption should be assessed later the same day or early the next day, following the same procedures as outlined in Section 3.3.1 of this appendix. The burning efficiency is then calculated as the weight of pre-burn divided by weight of post -burn vegetation, expressed as a percentage, in each size class for each vegetation fuel type.

3.3.7. Post-fire Burned Patchiness (%)

Post-fire patchiness must be assessed within five 1 x 10 m segments along the centreline of each transect. If using, drone-based assessments with a multi-spectral camera, post-fire orthophotos should be classified into two categories: burned and unburned Patches of pixels designated as remnant vegetation (categorised as vegetation and unburned)
< 1m2 burned patches should be filtered out to reduce errors resulting from misaligning pre- and post-fire images (see Russell-Smith et al. (2021); *3.3.1.4. Drone-based assessment of fire patchiness*). Patchiness data are only reported where at least 20% of a transect has burned.

3.3.8. Fire Characteristics and Post-fire Structural Vegetation Measures

Fire severity: Along the RHS of the transect in five 20 x 1 m transects scorch and / or char height (m) should be measured. Fire severity should then be evaluated using the following criteria:

- Low severity involved leaf scorch below 2 m;
- Moderate severity involved scorch heights above 2 m but below the tree canopy top; and
- High severity indicated scorching of the tree canopy itself (Russell-Smith et al. 2009).

Shrub health: Along the same sub-transects, the numbers of dead and living shrub stems per height class (<50 cm, 50cm -1m, 1-2 m, >2m) should also be measured.

Tree canopy cover and basal area should be measured post fire as per Section 3.3.3.

Appendix 2. Mapping guidelines for variable parameters

This technical guidance appendix contains:

- Section 1 – Requirements for creating, revising and validating vegetation fuel type maps
- Section 2 – Requirements for creating and validating monthly and seasonal burned area maps
- Section 3 – Requirements for creating Years Since Last Burned maps

1. Requirements for Creating a Vegetation Fuel Type Map

(Source: adapted from Savanna Technical Guidance Document v.1.0 – March 2018, by the Department of the Environment and Energy - Commonwealth of Australia) For all new projects and upon renewal of a crediting period, as a minimum, it is required that a Vegetation Fuel Type map be created and validated in accordance with this section. The validated Vegetation Fuel Type Map must be submitted for verification with the first project validation report or after a new project area is added to the Project.

Format of vegetation fuel type map

- Each project area must be covered by a single vegetation fuel type map.
- The map must be in raster format.
- All mapping units must be 30mx30m or less. Maps derived from multiple datasets must use similarly scaled data.
- The fuel type map must be based on data from +-3year of the start date of the project.
- Satellite data used for mapping fuel types must include dry and wet season imagery in order to better differentiate vegetation types.
- Burned area maps from the year prior to the date of the fuel type map should be incorporated in the classification, in order to account for the influence of previous fires in each vegetation type. Separate training data or thresholds should be defined for classification in areas that recently burned.
- The flow chart below illustrates the steps for creating and validating a vegetation fuel type map for a new project area.

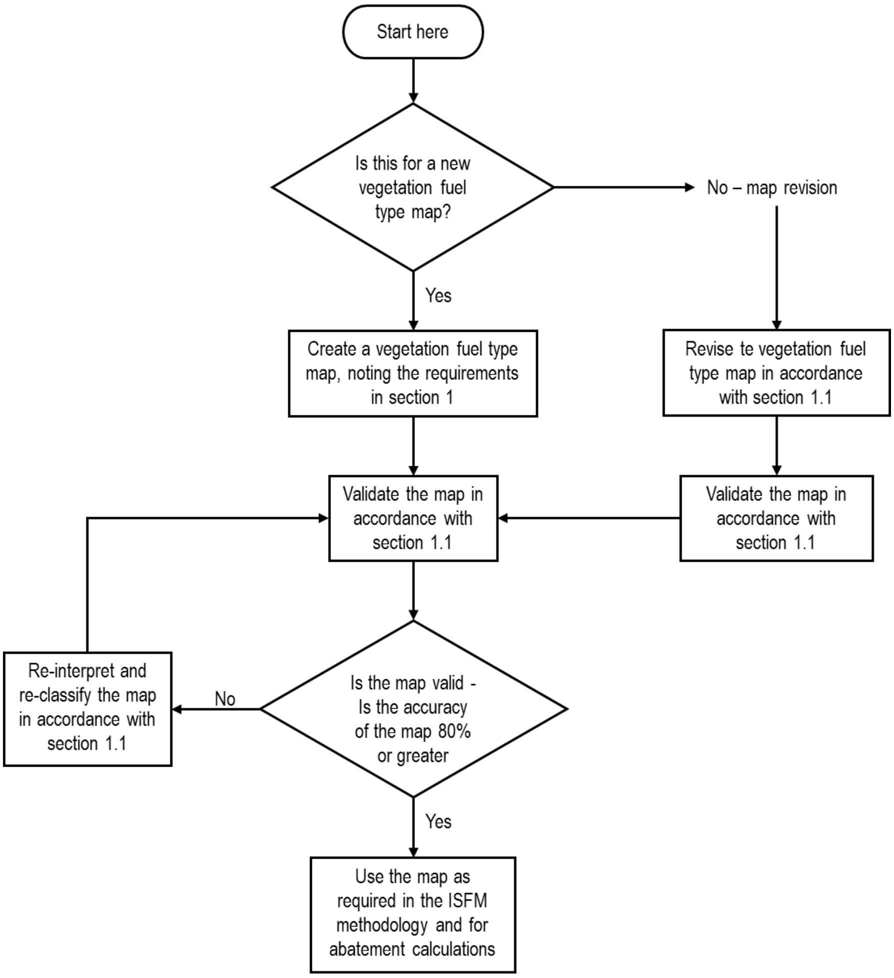

Figure 7 Steps required to create, revise and validate a vegetation fuel type map for a project area

Classification of mapping units in a vegetation fuel type map

Each mapping unit must be classified, by assigning a code, as containing either a vegetation fuel type as defined above, or otherwise classified as ineligible. Ineligible areas could include areas of land dominated by other vegetation fuel types, cleared land, water, or land used for agriculture or land containing other ecosystems.

Table 5 below provides an example of codes that could be assigned to each mapping unit. For the purposes of abatement estimates, all mapping units in each project area in a Vegetation Fuel Type map must be assigned a code for one of these vegetation fuel types described in the Project Description Document or be classified as 'ineligible'.

Table 5 Example of numerical codes that could be used and correspond to vegetation fuel types

Map code	Vegetation fuel type code	Vegetation fuel type name
1	**OFMi**	Open forest with mixed grasses
2	**WMi**	Woodland with mixed grasses
3	**OWMi**	Open Woodland with mixed grasses (including degraded open woodland)

Map code	Vegetation fuel type code	Vegetation fuel type name
4	**[OTH]**	[Other, e.g. shrubland with mixed grasses]
0	**Ineligible**	Vegetation that is not a vegetation fuel type, cleared land
255	**No Data**	i.e. mapping unit is outside the project area

Dominant vegetation fuel type

The dominant vegetation fuel type in each mapping unit is the vegetation fuel type that covers a greater area of land than is either occupied by any other vegetation fuel types or areas not occupied by a vegetation fuel type.

For example, a mapping unit that contains more than one vegetation fuel type would be classified according to the vegetation fuel type that occupies a proportion of the mapping unit that is greater than the proportion that is occupied by any other vegetation fuel types (see **Error! Reference source not found.** below). If the area occupied by vegetation not included as an eligible Vegetation Fuel Type is greater than any other Vegetation Fuel Type, then the mapping unit must be classified as ineligible.

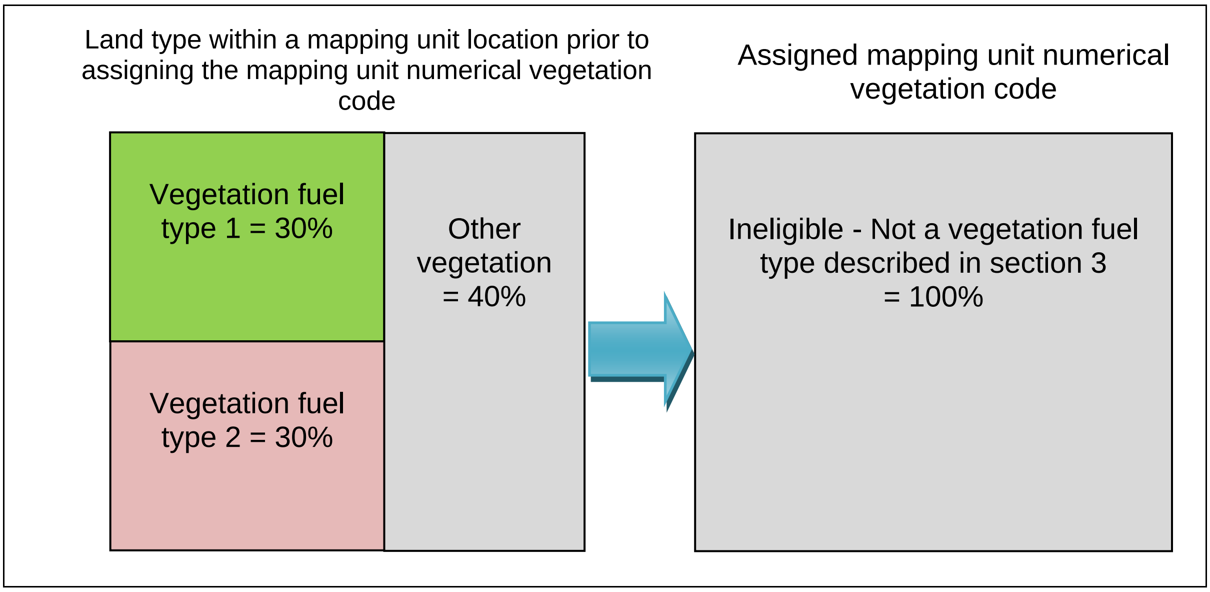

Figure 8 Example of how a mapping unit code is assigned. The mapping unit is occupied by a majority area of two vegetation fuel types. However, as the area that occupies the greatest proportion is not occupied by one of these vegetation fuel types, the mapping unit is assigned a numerical code to show that the mapping unit is ineligible.

Creating a vegetation fuel type map

The approach used to create a vegetation fuel type map depends on the available data and the experience of the person creating the vegetation fuel type map. The vegetation fuel type map may be derived by one or more of the following approaches:

1. *Remote-sensing data interpretation, using object-based image analysis techniques*

Object-based image analysis techniques derive the vegetation fuel type map by using suitable scale satellite imagery (e.g. Landsat 30m or higher resolution). Object-based image analysis techniques use image segmentation software, and can be used to segment imagery to create

homogenous objects. The segmentation process groups adjacent pixels according to their spectral signatures, contextual information and ancillary data. The consecutive classification process will classify the created image objects that best represent the vegetation fuel types.
The visible, near infrared and shortwave infrared (if available) bands of the satellite imagery, or multi-temporal composites of such, should be used to discern vegetation from satellite imagery. Other remote sensing data (e.g. aerial imagery or Laser scanning data) or existing geospatial products can be used if their use is clearly justified and if the vegetation fuel type map meets the accuracy criteria.
Ancillary information can assist in the stratification and differentiation of land and vegetation types. Ancillary data may be digital elevation models, soil type maps, geomorphological and hydrological data. Known associations between vegetation fuel types and land types can be used to inform the classification of the generated objects that represent patterns on the ground.

2. *Reclassifying an existing vegetation map product*

Existing map data sets must be carefully interpreted to ensure correct re-classification into the vegetation fuel types. An example of suitable mapping is the Regional Ecosystem mapping in Queensland, Australia. The mapping scale is 1:100,000 (i.e. minimum feature of 100m width or 4ha), and each Regional Ecosystem has a detailed description of the vegetation and the associated land type.
Existing vegetation maps at a spatial scale equal to or finer than that required may be re-classified to represent the vegetation fuel types. A detailed description of all input data and the process of reclassification is mandatory.

Vegetation map available in dMRV

A vegetation fuel type base map may be available as part of an approved dMRV system to provide broad scale approximations of vegetation fuel types for prospective savannas. This map may not necessarily meet the methodology requirements, and may not necessarily be used to estimate abatement in a report. The base map functionality may be provided to assist proponents with hypothetical abatement forecasts.

Calibration of vegetation fuel type

Calibration data from the land covered by the vegetation fuel type map must be collected to assist in the interpretation and classification of the new vegetation fuel type map – regardless of the approach used to initially create it. Calibration data must be independent of the data used to validate the map.

1.1. Validating a Vegetation Fuel Type Map

Vegetation fuel type maps must be validated in accordance with this document when they are newly created.

Vegetation fuel type maps that have been revised must also be validated in accordance with this document, and any revisions and validations must be completed before the project area is next reported on.

Validation of vegetation fuel type maps requires using a number of independent waypoints to determine the accuracy of the created or revised vegetation fuel type map. If map validation identifies that the proportion of errors is greater than an acceptable level, then the map must be re-interpreted and re-classified with a different set of waypoints.

Aerial sampling is recommended (over ground sampling) as it provides a more geographical representative sample set. If ground sampling is used, waypoints should be located at least 20-

50m into the vegetation away from the road, on some areas determined by stratification, and records should be kept of basal sweeps, and canopy cover estimates.
The data collector must have sufficient knowledge and experience to recognise the different vegetation fuel types described in the Project Description Document.

The following steps must be followed in order to validate a vegetation fuel type map. These are:

1. *Convert a copy of the map into vector format (the vectorised map), without simplifying or smoothing the polygon boundaries;*

The raster vegetation fuel type map must be converted to a vector map (the vectorised vegetation fuel type map). This assists with the format of the validation waypoint data.

Converting raster maps to vector maps is a standard function in GIS software. Most softwares will apply smoothing as a default, but for the purposes of validating the vegetation fuel type map care must be taken to ensure that the conversion does not simplify or smooth polygon boundaries. If conversion is correctly implemented, the vector boundaries will follow the same grid patterns as the raster map.

2. *Assign a numerical code to each polygon representing the code of the mapping unit or mapping units that comprise the polygon;*

Each polygon is assigned a single code to denote the vegetation fuel type contained in the polygon, or the fact that it contains ineligible land.

3. *Select an assessment set of waypoints from the set referred to in Section 1 of this appendix, having regard to all vegetation fuel types in the area covered by the map; and if the area covered by the map corresponds to land in different project areas—each such project area*

Activity participants must collect data for a set of validation waypoints (the assessment set). If a subset of a larger data set is used for validation, then the assessment set may be selected randomly or systematically, and must have regard to all vegetation fuel types and project areas in the vegetation fuel type map.

Each validation waypoint observation must remain independent of other waypoint validation observations. Waypoints cannot be deleted to improve the accuracy of assessment.

For the purposes of Verification and Validation, activity participants are advised to retain evidence that they did have regard to these matters when selecting waypoints, and that their decisions were fit for purpose.

Selection of waypoints
Validation waypoints must be:

1. Collected only within the area covered by the map that is being validated.
    a. Validation must prioritise a series of waypoints that cover the range of vegetation fuel types and traverse the extent of the mapped area.
2. Independent of any waypoints that were part of the calibration process used to classify or re-classify the map.
    a. One option that ensures that calibration and validation data are independent may include using different transects for the two purposes.

3. Identified by a unique label that includes:
    a. a unique label;
    b. the time of collection
    c. the date of collection; and
    d. the latitude and longitude of the waypoint derived from a GPS.
4. Selected having regard to transects that intersect, or a grid that intersects:
    a. all vegetation fuel types in the area covered by the map that is being validated;
    b. if the area covered by the map that is being validated corresponds to land in different project areas—each such project area; and
    c. Validation cannot use existing survey data where it cannot be shown that this did not have regard to the vegetation fuel types or the spatial extent of the mapped area.
5. Selected either randomly or systematically.

Waypoint buffers

Each waypoint must be surveyed using a circular buffer with a radius of 100m (totalling approximately 3.14ha) – the waypoint buffer. This allows for the waypoint to represent a homogenous area rather than a point, and ensures that the vegetation fuel type map validation is of a similar scale to the resolution of the map.

The waypoint buffer recognises that the survey is of a general area and not a point. The unique label, that includes the latitude and longitude of the waypoint derived from a GPS, represents the observation location.

Waypoint buffers cannot overlap. If waypoint buffers overlap, then an overlapping observation must be omitted from the validation data. The selection of omitted waypoints is at the discretion of the mapper, and must be selected having regard to the spatial distribution of the remaining waypoints.

Each waypoint buffer should be surveyed to visually assess the dominant vegetation structure, defined by the dominant canopy trees (e.g. *Eucalyptus* or *Melaleuca* or other), and the dominant understorey graminoid life form. This information is used to define whether the waypoint represents an eligible vegetation fuel type or ineligible land under the relevant determination. The rules for assessing areas containing more than one vegetation fuel type are the same to those for creating a vegetation map.

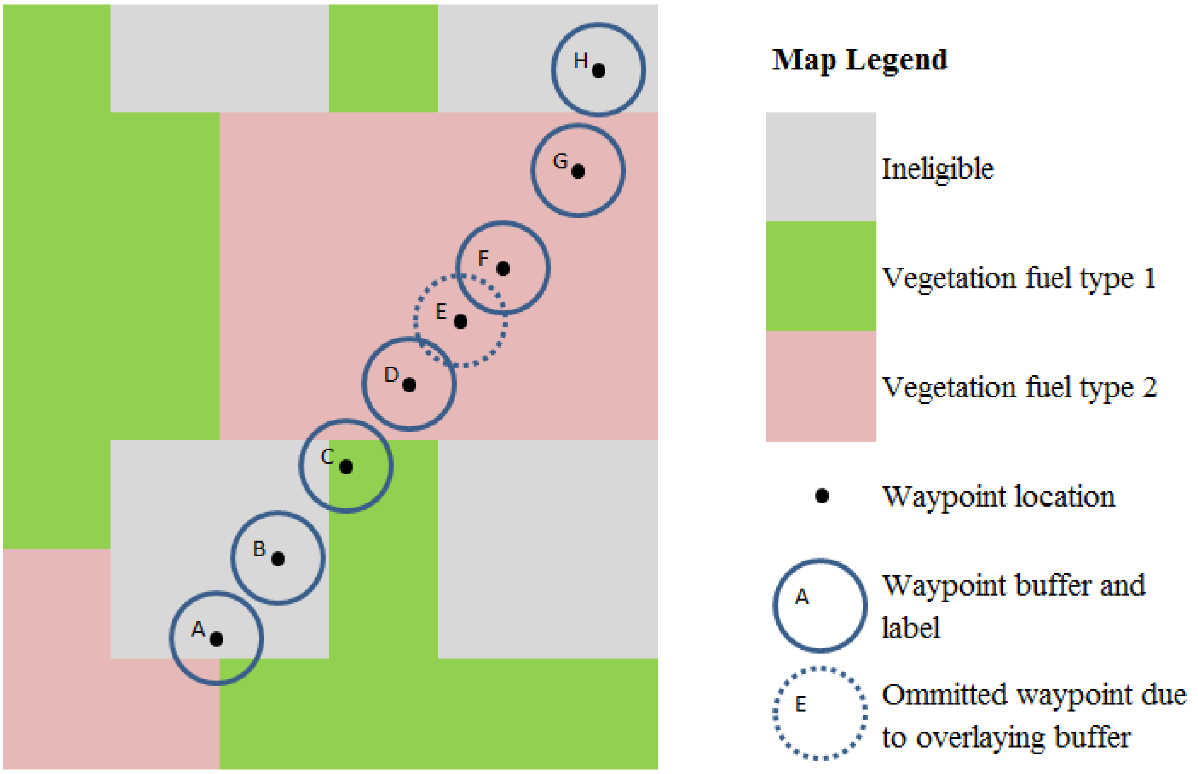

Figure 9 Buffered waypoints over a hypothetical vectorised vegetation fuel type map. Note: as pictured, waypoints do not represent a random or systematic sampling process

<u>Examples</u>

*The following example uses **Error! Reference source not found.** above to identify how the rules apply.*

Example A

Waypoint A has the code for vegetation fuel type 2 assigned to it. The waypoint latitude and longitude was recorded in the project area, and part of the waypoint buffer overlays an area of the vectorised vegetation fuel type map of the same code. The waypoint buffer does not overlap another waypoint buffer so this waypoint is both an assessed and verified waypoint.

Example B

Waypoint E buffer overlaps with the waypoint buffers of D and F. The mapper could delete waypoints D and F, leaving E, but chooses to delete only E. E becomes an omitted waypoint and does not contribute to either the number of assessed or verified waypoints. The waypoint buffers for waypoints D and F do not overlap with any other waypoint buffer so they are both included in the number of assessed waypoints. D and F are assigned the codes for vegetation type 1 but no part of their buffers overlap with an area of the vectorised vegetation fuel type map of the same code. Waypoints D and F are an assessed waypoint but not a verified waypoint.

Number of waypoints required for validation

Waypoints must be collected at approximately the same time as the vegetation fuel type map was created and validated – ideally within three years of the map creation or revision.

The minimum number of waypoints required to validate a new or revised vegetation fuel type map, regardless of the number of project areas it covers, is determined in accordance with Table 6 below.

Table 6 Minimum number of waypoints

Area of vegetation fuel type map	Minimum number of waypoints
> 20,000km^2	500 plus 1 waypoint for every 100km^2 over 20,000km^2
10,000km^2–20,000km^2	500
10,000km^2 – 5,000km^2	250
<5,000km^2	125

The number of waypoints used for validation is that estimated to ensure an acceptable level of confidence in the accuracy of the vegetation fuel type map. Vegetation fuel type maps used in the relevant determination must demonstrate 80 per cent accuracy or greater. The accuracy of the map (in percentage) is given by the following formula:

$$\text{accuracy} = \frac{\text{number of verified waypoints}}{\text{number of assessed waypoints}} \times 100$$

Where:

assessed waypoint means a waypoint in the assessment set.

verified waypoint means a waypoint in the assessment set that has the same code in any part of the buffer area with an area of land that it overlaps in the vectorised vegetation fuel type.

A waypoint is a verified waypoint if any of the land in the waypoint has the same vegetation cover as that same area of land in the vegetation fuel type map being validated.
The accuracy of the map must be 80%or greater.

Example 1

A new project has two project areas mapped on a single vegetation fuel type map. Each project area is 4,000km2. The sum of these areas is 8,000km2 so at least 250 waypoints are required to validate the single vegetation fuel type map.

If the project areas were mapped separately, then a minimum of 250 waypoints would be required for each vegetation fuel type map representing a single project area (i.e. a total minimum of 500 waypoints).

Example 2

An existing project has one project area of 4,000 km2. This vegetation fuel type map was validated using 300 waypoints. Several years later, the project decides to vary their declaration and add a second project area, also of 4,000km2. As this is a variation under section 29 of the Act, then the number of waypoints required to validate the new vegetation fuel type map must be a minimum of 250.

1.2. Re-interpretation and Re-Classification of a Vegetation Fuel Type Map

If validation of a vegetation fuel type map demonstrates an accuracy of less than 80%, then the vegetation fuel type map must be re-interpreted and re-classified. Re-interpretation and re-classification can be achieved by refining the interpretation of the original vegetation fuel type map, such as refinement of the interpretation of remote sensing data. The revised map must be validated to an acceptable level of accuracy.

Validation of a re-interpreted and re-classified map must use the number of waypoints defined in Table 6. Waypoints must be selected in accordance with the guidelines provided in this section. These waypoints may be taken from the assessment set or may include new waypoints used for the purposes of this validation. Activity participants must not use the waypoints that were used when seeking to validate the corresponding seasonal burned area map, nor information from them.

1.3. Timing of Validation of New or Revised Vegetation Fuel Type Maps

Initial map validation must occur no earlier than three years before the project or project area was added (e.g. at project start date); and no later than when the first report is submitted that relies on that map. Map validation of revised maps must also occur within these time frames.

1.4. Revising a Vegetation Fuel Type Map

A vegetation fuel type map must be revised if any mapping unit classified as containing a vegetation fuel type in the original vegetation fuel type map was later found to be classified incorrectly and should now be classified as ineligible. This could occur if an error was made in the initial mapping of the land, or land use /land use cover changes over time.

A vegetation fuel type map must also be revised if the classification is not, or is no longer, in accordance with this guidance. For example, the mapping unit may be classified as one vegetation fuel type, but should be classified as another vegetation fuel type.

It is optional to revise a vegetation fuel type map if any mapping unit classified as ineligible in the original vegetation fuel type map was later found to be classified incorrectly and should now be classified as a vegetation fuel type. For example, a vegetation fuel type may be revised if a new vegetation fuel type is added at a date later than when the original vegetation fuel type map was created.

If a vegetation fuel type map is revised it must be validated in accordance with the following instructions. If revisions are required, then the revision (and if necessary) validation must be completed before submitting a report for the reporting period in which the activity participants became aware that the revision was required. The validation must be completed before submitting a report for the first reporting period for which the revised map is used.

Validating revised vegetation fuel type maps

If a vegetation fuel type map is revised, then it may be required to be validated. The revisions are considered to require validation if, for at least one criteria below, the revisions comprise at least 5% of the defined area.

1. The extent of land covered by all revised mapping units cover at least 5% of the extent of land when compared to the extent of land containing all vegetation fuel– either before or after the map was revised, or
2. The extent of land covered by revisions to an individual vegetation fuel type cover at least 5% of the extent of land when compared to the extent of land covered by that vegetation fuel type – either before or after the map was revised, or
3. For a vegetation fuel type map that covers more than one project area, either of the above hold for any of the individual project areas, or
4. The cumulative impact of more than one map revision would have the same effect as any of the above provisions.

If 5% or greater of the vegetation fuel type map has been revised in accordance with one or more of these criteria, then the whole of the revised vegetation fuel type map must be validated.
If none of these criteria are met, then validation is not required.

All new validation waypoints must be independent of any waypoints that have previously been used to validate the map or any earlier version of the map. All newly selected waypoints must be selected as per Section 1.1 of this appendix. If the revised map is not valid, then it must be re-interpreted and re-classified according to Section 1.2 of this appendix, without using waypoints that were used to validate the original or revised map, nor information from either.

2. Requirements for Creating and Validating Monthly and Seasonal Burnt Area Maps

This section provides the requirements for creating and validating seasonal burned area maps. Seasonal burned area maps are used in the calculations of estimated abatement for each calendar year, and to determine the years since each mapping unit was last burned.

Activity participants that use an approved dMRV will not need to create their own seasonal burned area maps. Burned area maps used in the approved dMRV will be of an acceptable accuracy for estimating abatement.

Activity participants not using the approved dMRV must follow the requirements set out in this section.

2.1. Creation of Monthly Burn Area Maps

Validated monthly burned area maps are used to create seasonal burned area maps.

Monthly burned area maps must be created in raster format with a mapping unit size at the finest possible resolution when comparable to the resolution of the vegetation fuel type map. Monthly burned area maps must cover the entire area of land covered by each project area in the project.

The approach for creating monthly burned area maps is similar to that for creating vegetation fuel type maps. The principles outlined for the creation of vegetation fuel type maps described in Section 1 of this appendix also must be adhered to when creating monthly burned area maps.

For each season (EDS or LDS), and preferably for each month in the calendar year, a numerical code must be assigned to each mapping unit that denotes whether the mapping unit was burned or unburned.

- If more than half of the area of the mapping unit is attributed as having been burned in that calendar month, then a numerical code of 1 is assigned to demonstrate that the mapping unit was ‘burned’.
- If less than half of the area of the mapping unit is attributed as having been burned in that calendar month, then a numerical code of zero is assigned to demonstrate that the mapping unit was ‘unburned’.

2.2. Creation of Seasonal Burnt Area Maps from Monthly Burnt Area Maps

For each project area, seasonal burned area maps must be created for each fire season in each calendar year in the historical reference period and for each project year being reported on. These maps must be in raster format and have the finest possible resolution when compared to that of the resolution of the vegetation fuel type map. Each seasonal burned area map must cover the entire relevant project area.

Seasonal burned area maps assign a code that classifies each mapping unit as having been attributed as being either burned or unburned in the months that are covered by either the early dry season or the late dry season. The monthly burned area maps are used to determine whether the mapping unit was attributed as having been burned or unburned in each fire season. Each monthly burned area map used to create each seasonal burned area map for a particular year must be derived from a single satellite imagery product.

Section 10.2.2 of this methodology defines the date on which the Early Dry Season and the Late Dry season start and end, and may be define as a spatial data layer, which must be compared with the monthly burned area maps when developing the seasonal burned area map. This allows for burned areas in each month in each mapping unit to be accurately represented as being in either the early or the late dry season. For areas that burned more than once within the same year, only the earlier fire is counted.

It is possible that these two spatial data layers may indicate different dates for the start and end of the late dry season for different areas of land within a single project area. When this occurs, the seasonal burned area map must reflect the date defined as the start and end of the late dry season for each mapping unit, such that the final seasonal burned area map shows all burned and unburned mapping units in either the early dry season or the late dry season.

2.3. Validation of Seasonal Burnt Area Maps

All seasonal burned area maps used for manual calculations for abatement estimates must be validated.

The validation approach, including the validation survey, is the same as that used for validating vegetation fuel type maps and described in Section 1.1 of this appendix, with the addition that sampling may be done using contemporaneous satellite imagery (i.e. aerial surveys or ground surveys are not mandatory. This is because burned areas are more easily detectable through remote sensing).

The same approach for validating maps as described in Appendix 2 must be used for validating seasonal burned area maps. All the same steps are required for the validation of each seasonal burned area map. These can be summarised as:

1. *Convert a copy of the map into vector format (the vectorised map), without simplifying or smoothing the polygon boundaries*
2. *Assign a numerical code to each polygon representing the code of the mapping unit or mapping units that comprise the polygon*
3. *Select an assessment set of waypoints from the set referred to Section 1 of this appendix, having regard to both burned and unburned areas in the area covered by the map; and if the area covered by the map corresponds to land in different project areas—each such project area*

Each waypoint must be selected randomly or systematically. Each waypoint must be surveyed using a circular buffer with a radius of 100 metres (totalling approximately 3.14 hectares) – the waypoint buffer. This allows for the waypoint to represent a homogenous area rather than a point, and ensures that the seasonal burned area map validation is of a similar scale to the resolution of the map.

The waypoint buffer must be designated by a numerical value of 1 if burned or 0 if unburned. The minimum number of waypoints is determined according to Section 1.1 of this appendix.

The accuracy of the map must be 80 per cent or greater.

Timing of validation of new or revised seasonal burned area maps

Seasonal burned area maps must be validated for the applicable season to which they refer. Each seasonal fire map must be validated at a time when each burned area is still visible (typically within 6 months).

2.4. Re-interpretation and Re classification of Monthly Burnt Area Map

If validation of a seasonal burned area map demonstrates an accuracy of less than 80 per cent, then the seasonal burned area map must be re-interpreted and re-classified. Re-interpretation and re-classification can be achieved by refining the interpretation of the original seasonal burned area map, such as refinement of the interpretation of remote sensing data. The revised map must be validated to an acceptable level of accuracy.

Validation of a re-interpreted and re-classified map must use the number of waypoints defined in Table 6, and selected in accordance to the guidelines provided in that section. These waypoints may be taken from the assessment set or may include new waypoints used for the purposes of this validation. Activity participants must not use the waypoints that were used when seeking to validate the corresponding seasonal burned area map, nor information from them.

3. Requirements for Creating Years Since Last Burned (YSLB) Maps

A Year Since Last Burned (YSLB) map must be produced for each calendar year in the historical reference period and each calendar year in the crediting period.

A YSLB map shows how many years have elapsed since each mapping unit that was burned in the current calendar year was last burned. The Year Since Last Burned maps are used to determine fine and shrub fuel loads in each mapping unit. These fuel loads are used to estimate abatement from emissions reduction.

Activity participants that use an approved dMRV will not need to create their own seasonal burned area maps. Burned area maps used in an approved dMRV will be of an acceptable accuracy for estimating abatement.

Activity participants not using an approved dMRV must follow the requirements set out in this section.

Creating Year Since Last Burned (YSLB) maps

Year Since Last Burned maps must be created for each calendar year in the historical reference period and the crediting period. These maps must be created using GIS software, be a geospatial map in raster format and have the finest possible resolution at a scale comparable to that used for the vegetation fuel type map.

Each Year Since Last Burned map must cover the entire land area of each project area.
A number of steps must be followed to create a Year Since Last Burn map for each calendar year. These are:

1. Generate yearly fire maps for the calendar year y that the Year Since Last Burn map is being created, and for each of the relevant preceding calendar years. This is achieved by aggregating either monthly burned area maps or seasonal burned area maps created and validated in accordance with Section 2 of this appendix. This may require burned area data from x years (up to 5 years or more) prior to each calendar year y in the historical reference period and all years of the crediting period.
2. Assign a code to each mapping unit of each yearly burned area map generated – either 1 to denote a burned area or zero to denote an unburned area.

3. Generate the Year Since Last Burn map by assigning a numerical code to each mapping unit (year y).

    a. If the mapping unit was unburned in calendar year y then the numerical code assigned to that mapping unit is zero. These mapping units are not used in calculations of estimated abatement.

    b. If the mapping unit was burned in calendar year y, but not burned in any of the preceding x years according to the maps generated in (a), then assign the numerical code x+1 which denotes that the mapping unit was previously burned more than ten years since calendar year y.

    c. If the mapping unit was burned in calendar year y, and was burned in at least one of the previous x years according to the maps generated, then assign a numerical code equal to the number of years between calendar year y and the most recent time since that mapping unit was burned. For example, if five years have elapsed since the mapping unit last burned, the mapping unit is assigned a code of 5; if three years have elapsed, then the mapping unit is assigned a code of 3.

    d. If data is not available for the past x years due to the previous x years extending earlier than the available data, then the mapping unit is assigned a conservative code of x+1.

Appendix 3. Guidance on propagating error in uncertainty calculations

Note on annual independence of uncertainty (no cumulative carry-over across years).

For savanna fire management, key determinants of fire behaviour—fine-fuel moisture, fine-fuel load, patchiness, ignition conditions, and burned area—are reset by the wet season each year. As a result, the uncertainty associated with mapping and parameterization for year *y* is year-specific and does not compound over time.
In practice, we (i) quantify per-year standard errors for activity data and factors, (ii) propagate them within each year's emissions calculation, and then (iii) derive the uncertainty of multi-year aggregates (e.g., HRP mean) using standard statistics for independent annual observations (i.e., standard error of the mean), rather than summing annual uncertainties across years.
This approach aligns with the Baseline Standard's requirement to quantify uncertainty in the ex-ante unadjusted baseline (first-year downward adjustment) and avoids overstating uncertainty through inappropriate temporal accumulation.

1. Propagating error from area classification

Standard error for each monthly burn map is calculated using equation (29):

$$S(FSA_{p,PA,y,m}) = FSA_{p,PA,y,m} \times \frac{100 - \%BA_{p,PA,y,m}}{2} \tag{29}$$

Where:

$S(FSA_{b,PA,y,m})$	=	Standard error of fire surface area, in the calculation period *p* within the Project Area, observed in year *y* during month *m* (ha)
$FSA_{p,PA,y,m}$	=	Fire surface area, in the calculation period *p* within the Project Area, observed to have burnt in year *y* during month *m* (ha).
$\%BA_{p,PA,y,m}$	=	The percent accuracy obtained in estimating area burnt (%) in the calculation period *p* within the Project Area, observed in year *y* during month *m* when validating a monthly burnt area map
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
m	=	Month of the year for which an area burnt map was created

The vegetation fuel type map also carries uncertainty within it, which is converted into standard error using equation (30)**Error! Reference source not found.**:

$$S(A_{PA,v}) = A_{PA,v} \times \frac{100 - \%VA_{PA,v}}{2} \tag{30}$$

Where:

$S(A_{PA,v})$	=	Standard error of area (ha) in the Project Area covered by vegetation fuel type *v*
$A_{PA,v}$	=	Area (ha) in the Project Area covered by vegetation fuel type *v*
$\%VA_{PA,v}$	=	The percent accuracy obtained in estimating area (%) of vegetation fuel type *v* for the Project Area when validating a vegetation fuel type map.
PA	=	Boundary type: Project Area
v	=	Eligible vegetation fuel type

As demonstrated in Equation (3), fire surface areas are stratified by vegetation type. Standard error is propagated here assuming that the fire surface area containing vegetation type *v* is calculated by dividing values derived from the area burnt maps from values derived from the vegetation type map. Equation (31). below thus propagates the standard error assumed in the stratification of fire surface area by vegetation type:

$$S(VTA_{p,PA,v,y,m}) = |VTA_{p,PA,v,y,m}| \times \sqrt{\left(\frac{S(FSA_{p,PA,y,m})}{FSA_{p,PA,y,m}}\right)^2 + \left(\frac{S(A_{PA,v})}{A_{PA,v}}\right)^2} \quad (31)$$

Where:

$S(VTA_{p,PA,v,y,m})$	=	Standard error of vegetation type area in calculation period *p* within the Project Area covered by vegetation fuel type *v* contained by a fire surface area in year *y* during month *m* (ha)
$S(FSA_{p,PA,y,m})$	=	Standard error of fire surface area in calculation period *p* within the Project area observed to have burnt in year *y* during month *m* (ha) – from equation (29)
$FSA_{p,PA,y,m}$	=	Fire surface area in the calculation period *p* within the Project Area, observed to have burnt in year *y* during month *m*
$S(A_{PA,v})$	=	Standard error of area (ha) covered by vegetation fuel type *v* – from equation (30)
$A_{PA,v}$	=	Area (ha) covered by vegetation fuel type *v*
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
m	=	Month of the year for which an area burnt map was created

When vegetated area within monthly fire surface areas are summed across all EDS and LDS monthly burn maps, the standard error from each map is propagated across the summations using equation (32):

$$S(VTA_{p,PA,v,y,s}) = \sqrt{\sum_m S(VTA_{p,PA,v,y,m})^2} \quad (32)$$

Where:

$S(VTA_{p,PA,v,y,s})$	=	Standard error of vegetation type area in calculation period p within the Project area covered by vegetation fuel type *v* contained by a fire surface area in year *y* during fire season *s* (ha)
$S(VTA_{p,PA,v,y,m})$	=	Standard error of vegetation type area in calculation period p within the Project area covered by vegetation fuel type *v* contained by a fire surface area in year *y* during month *m* (ha) – from Equation (31)
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
m	=	Month of the year for which an area burnt map was created
s	=	Fire season: Early Dry Season or Late Dry Season: the months of the calendar year that will fall into each season will depend on the project site.

Vegetation fuel type areas within fire surface areas are further stratified into vegetation cohort areas based on years-since-last-burnt data, each of which is converted into fuel load estimates using default values that are unique to that cohort, depending on the year that a particular area was last burnt.

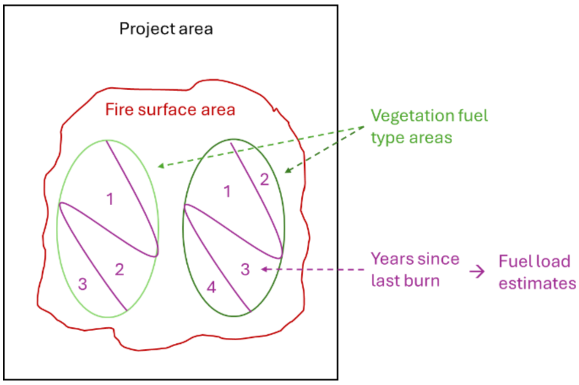

Figure 10 Fuel load diagram showing a conceptual summary of how burnt areas in different Vegetation Fuel Types can be grouped into cohorts of areas with the same fire history (Years Since Last Burnt).

This is accomplished by converting area burnt maps into Years Since Last Burnt maps, which further stratifies the project area based on the areas burnt in the previous years. For example, in Miombo ecosystems, the standard error associated with the vegetation cohort types, the accumulation of all area estimates and accuracy exercises will result in 24 vegetation cohort areas for every year of accounting: 6 for every Year Since Last Burnt (0,1,2,3,4,5+), times two for the early dry season and late dry season, times two for each vegetation fuel type. Each area estimate of these 24 strata will have its own unique standard error, based on 1) the error from the vegetation fuel type map from the relevant crediting period, 2) the sum of errors from all monthly burn maps used, and 3) the sum of errors from the current area burnt map and the area burnt maps from the previous six years.

2. Propagating Error from Fuel Load factors

Each vegetation cohort area of vegetation fuel type *v* burnt in season *s* during year *y* that was last burnt *YSLB* years ago ($VCA_{YSLB,v,y,s}$) is multiplied by fuel accumulation factors and converted into fuel load estimates in tonnes per hectare. Equation (10) involves two summations across the cohort strata, a multiplication of area by factor, and a division of the two summations. Each operation propagates error differently, so standard error associated with equation (10) is split across the following equations to clearly propagate the error of each computational step, beginning with the summation of vegetation cohort areas across cohort in equation (33).
Note: the summation vegetation cohort areas across all YSLB cohorts will be identical to the vegetation type area, but the standard error carried in this equation is different from that described in equation (32), which only accounts for inaccuracy in the vegetation type map and the area burnt maps of year y. The standard error propagated within equation (33).**Error! Reference source not found.** below also includes the inaccuracies of the burnt area maps used to create the *YSLB* maps for year *y*.

$$S(VCA_{p,PA,v,y,s}) = \sqrt{\sum_{YSLB} S\left(VCA_{p,PA,YSLB,v,y,s}\right)^2} \qquad (33)$$

Where:

$S(VCA_{p,PA,v,y,s})$	=	Standard error of vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type *v* burnt in season s during year *y* (ha)
$S\left(VCA_{p,PA,YSLB,v,y,s}\right)$	=	Standard error of the vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type *v* burnt in season *s* during year *y* that was last burnt *YSLB* years ago (ha)
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)

PA	=	Boundary type: Project Area
$YSLB$	=	Cohort age, based on the years since last burnt
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s	=	Fire season: Early Dry Season or Late Dry Season

Next, some multiplication and summation steps that are summarized in equation (10) are here broken down into smaller parts, as seen here in equation (34) as to more clearly demonstrate each step in propagating error.

$$FLT_{p,PA,i,v,y,s} = \sum_{YSLB} VCA_{p,PA,YSLB,v,y,s} \times FA_{YSLB,i,v,s} \tag{34}$$

Where:

$FLT_{p,PA,i,v,y,s}$	=	Fuel load total in calculation period *p* within the Project Area, contained in fuel class i of vegetation fuel type v burnt in year y during season s (t)
$VCA_{p,PA,YSLB,v,y,s}$	=	Vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type v burnt in season s during year y that was last burnt YSLB years ago (ha)
$FA_{YSLB,i,v,s}$	=	Fuel accumulation factor for fuel class i in vegetation type v burnt in season s that was burnt YSLB years ago
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
$YSLB$	=	Cohort age, based on the years since last burnt
i	=	Fuel class (ie, fine, coarse, woody, shrubby)
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s	=	Fire season: Early Dry Season or Late Dry Season

Equation (35) below demonstrates how error is propagated across the two computational steps outlined in equations **Error! Reference source not found.**above.

$$S(FLT_{p,PA,i,v,y,s}) = \sqrt{\sum_{YSLB}\left(\left|VCA_{p,PA,YSLB,v,y,s} \times FA_{YSLB,i,v,s}\right| \times \sqrt{\left(\frac{S(VCA_{p,PA,YSLB,v,y,s})}{VCA_{p,PA,YSLB,v,y,s}}\right)^2 + \left(\frac{S(FA_{YSLB,i,v,s})}{FA_{YSLB,i,v,s}}\right)^2}\right)^2} \tag{35}$$

Where:

$S(FLT_{p,PA,i,v,y,s})$	=	Standard error of fuel load total in calculation period *p* within the Project Area, contained in fuel class i of vegetation fuel type v burnt in year y during season s (t)
$VCA_{p,PA,YSLB,v,y,s}$	=	Vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type v burnt in season s during year y that was last burnt YSLB years ago (ha)
$FA_{YSLB,i,v,s}$	=	Fuel accumulation factor for fuel class i in vegetation type v burnt in season s that was burnt YSLB years ago
$S(VCA_{p,PA,YSLB,v,y,s})$	=	Standard error of the vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type v burnt in season s during year y that was last burnt YSLB years ago (ha)
$S(FA_{YSLB,i,v,s})$	=	Standard error of the fuel accumulation factor for fuel class i in vegetation type v burnt in season s that was burnt YSLB years ago

p = Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA = Boundary type: Project Area
$YSLB$ = Cohort age, based on the years since last burnt
i = Fuel class (ie, fine, coarse, woody, shrubby)
v = Eligible vegetation fuel type
y = Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s = Fire season: Early Dry Season or Late Dry Season

Finally, all the computational steps that propagate error across the parameters of equation (10) are consolidated here in equation (36):

$$S(FL_{p,PA,i,v,y,s}) = \left|FL_{p,PA,i,v,y,s}\right| \times \sqrt{\left(\frac{S(FLT_{p,PA,i,v,y,s})}{FLT_{p,PA,i,v,y,s}}\right)^2 + \left(\frac{S(VCA_{p,PA,v,y,s})}{VCA_{p,PA,v,y,s}}\right)^2} \quad (36)$$

Where:
$S(FL_{p,PA,i,v,y,s})$ = Standard error of fuel load in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t/ha)
$FL_{p,PA,i,v,y,s}$ = Fuel load in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t) – from Equation (10)
$S(FLT_{p,PA,i,v,y,s})$= Standard error of fuel load total in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t) – from equation (35)**Error! Reference source not found.** above
$FLT_{p,PA,i,v,y,s}$ = Fuel load total in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t)– from equation (34) above
$S(VCA_{p,PA,v,y,s})$= Standard error of vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type v burnt in season s during year y (ha) – from equation (33)**Error! Reference source not found.** above
$VCA_{p,PA,v,y,s}$ = Vegetation cohort area in calculation period *p* within the Project area covered by vegetation fuel type v burnt in season s during year y (ha)– is equal to the vegetation type area of vegetation fuel type v burnt in season s during year y ($VCA_{v,y,s}$)
p = Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA = Boundary type: Project Area
i = Fuel class (ie, fine, coarse, woody, shrubby)
v = Eligible vegetation fuel type
y = Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s = Fire season: Early Dry Season or Late Dry Season

3. Propagating Error from Emission factors

Equation (9) converts fuel load into potential fire emissions by multiplying each fuel load value by a series of burn efficiency and emission conversion factors. Once again, the different computational steps summarized in this equation are broken down into several equations below to propagate error.

First, every unique fuel load value across fuel class and season is multiplied by a burn efficiency factor, derived from Appendix 1 or other regionally appropriate sources. Then, the products are summed across all fuel classes. To clearly propagate error, this section once again breaks apart components of equations from earlier in the computational process into smaller pieces, as show in equation (37) below:

$$FC_{p,PA,v,y,s} = \sum_{i} FL_{p,PA,i,v,y,s} \times BCF_{i,v,s} \tag{37}$$

Where:

$FC_{p,PA,v,y,s}$	=	Fuel consumed in calculation period p within the Project Area from eligible vegetation fuel type v burnt in year y of fire season s (t/ha)
$FL_{p,PA,i,v,y,s}$	=	Fuel load in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t/ha)– from Equation (9)
$BCF_{i,v,s}$	=	Burning Combustion Efficiency for eligible fuel size class i, for eligible vegetation type v, in fire season s (%)
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
i	=	Fuel class (ie, fine, coarse, woody, shrubby)
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s	=	Fire season: Early Dry Season or Late Dry Season

As a summation of several multiplications, the standard error from these two computational steps is propagated using equation (38) below:

$$S(FC_{p,PA,v,y,s}) = \sqrt{\sum_{i} \left(\left| FL_{p,PA,i,v,y,s} \times BCF_{i,v,s} \right| \times \sqrt{\left(\frac{S(FL_{p,PA,i,v,y,s})}{FL_{p,PA,i,v,y,s}} \right)^2 + \left(\frac{S(BEF_{i,v,s})}{BEF_{i,v,s}} \right)^2} \right)^2} \tag{38}$$

Where:

$S(FC_{p,PA,v,y,s})$	=	Standard error of fuel consumed in calculation period p within the Project Area from eligible vegetation fuel type v burnt in year y of fire season s (t/ha)
$FL_{p,PA,i,v,y,s}$	=	Fuel load in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t/ha) – from Equation (9)
$BCF_{i,v,s}$	=	Burning Efficiency for eligible fuel size class i, for eligible vegetation type v, in fire season s (%)
$S(FL_{i,v,y,s})$	=	Standard error of fuel load in calculation period *p* within the Project Area, contained in fuel class i in vegetation fuel type v burnt in season s during year y (t/ha) – from equation (36)
$S(BCF_{i,v,s})$	=	Standard error of Burning Combustion Efficiency for eligible fuel size class i, for eligible vegetation type v, in fire season s (%)
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
i	=	Fuel class (ie, fine, coarse, woody, shrubby)
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s	=	Fire season: Early Dry Season or Late Dry Season

Next, the fuel load and burn efficiency products are further multiplied by several season-, vegetation- and GHG-specific conversion factors, as well as the molar-to-elemental mass and global warming potential values per GHG gas, to estimate the potential fire emissions. As a series of multiplications, equation (39)**Error! Reference source not found.** below propagates standard error for this computational step. Note that the factors that do not have standard error values (the molar-to-elemental mass and global warming potential values per GHG gas) do not undergo any summation of least squares.

$$S\left(PFE_{p,PA,g,v,y,s}\right) = \left|PFE_{p,PA,g,v,y,s}\right| \times \sqrt{\left(\frac{S(FC_{p,PA,v,y,s})}{FC_{p,PA,v,y,s}}\right)^2 + \left(\frac{S(CC_{v,s})}{CC_{v,s}}\right)^2 + \left(\frac{S(EC_{g,v,s})}{EC_{g,v,s}}\right)^2 + \left(\frac{S(EF_{g,v,s})}{EF_{g,v,s}}\right)^2} \quad (39)$$

Where:

$S\left(PFE_{p,PA,g,v,y,s}\right)$	=	Standard error of potential fire emissions in calculation period p within the Project area from eligible greenhouse gas g, from burnt vegetation type v in year y during season s (tCO2e)
$PFE_{p,PA,g,v,y,s}$	=	Potential fire emissions in calculation period p within the Project area from eligible greenhouse gas g, from burnt vegetation type v in year y during season s (tCO2e) – from Equation (9)
$S(FC_{p,PA,v,y,s})$	=	Standard error of fuel consumed in calculation period p within the Project Area from in vegetation fuel type v burnt in season s during year y (t/ha)– from equation (38) above.
$FC_{p,PA,v,y,s}$	=	Fuel consumed in calculation period p within the Project Area from vegetation fuel type v burnt in season s during year y (t/ha)– from equation (37) above.
$S(\mathrm{CC}_{v,s})$	=	Standard error of Carbon Content for vegetation fuel type v, for fire season s (%)
$\mathrm{CC}_{v,s}$	=	Carbon Content for vegetation fuel type v, for fire season s (%)
$S(EC_{g,v,s})$	=	Standard error of ratio to convert other elements to carbon, for greenhouse gas g, for fuel size class i, for vegetation fuel type v, for season s
$EC_{g,v,s}$	=	ratio to convert other elements to carbon, for greenhouse gas g, for fuel size class i, for vegetation fuel type v, for season s
$S(\mathrm{EF}_{g,\mathrm{i,v,s}})$	=	Standard error of emission factor for eligible greenhouse gas g, for eligible fuel size class i, for vegetation fuel type v, for fire season s (%)
$\mathrm{EF}_{g,\mathrm{v,s}}$	=	Emission Factor for eligible greenhouse gas g, for eligible fuel size class i, for vegetation fuel type v, for fire season s (%)
p	=	Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA	=	Boundary type: Project Area
i	=	Fuel class (ie, fine, coarse, woody, shrubby)
g	=	Greenhouse gas
v	=	Eligible vegetation fuel type
y	=	Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s	=	Fire season: Early Dry Season or Late Dry Season

In equation (7), the potential fire emissions factor is multiplied by the area burnt in year *y* of vegetation type *v*, and by a patchiness factor unique to the vegetation type and season. The standard error of the multiplication of these factors by vegetation cohort area is propagated using equation (40) below:

$$S(E_{p,PA,f,g,v,y,s}) = \left|PFE_{p,PA,g,v,y,s} \times VCA_{p,PA,v,y,s} \times P_{v,s}\right| \times \sqrt{\left(\frac{S(PFE_{p,PA,g,v,y,s})}{PFE_{p,PA,g,v,y,s}}\right)^2 + \left(\frac{S(VCA_{p,PA,v,y,s})}{VCA_{p,PA,v,y,s}}\right)^2 + \left(\frac{S(P_{v,s})}{P_{v,s}}\right)^2} \quad (40)$$

Where:

$S(E_{p,PA,f,g,v,y,s})$	=	Standard error of emissions in calculation period p within the Project Area from fires by greenhouse gas g, burnt in vegetation type v in year y during season s (tCO2e)

$PFE_{p,PA,g,v,y,s}$ = potential fire emissions in calculation period p within the Project area from eligible greenhouse gas g, from burnt vegetation type v in year y during season s – from Equation (9)
$VCA_{p,PA,v,y,s}$ = Fuel cohort area in calculation period p within the Project area of vegetation fuel type v burnt in season s during year y
$P_{v,s}$ = Patchiness factor for vegetation type v in season s
$S(PFE_{p,PA,g,v,y,s})$= Standard error potential fire emissions in calculation period p within the Project area from eligible greenhouse gas g, from burnt vegetation type v in year y during season s – from equation (39) **Error! Reference source not found.** above
$S(VCA_{p,PA,v,y,s})$ = Standard error of vegetation cohort area in calculation period p within the Project area of vegetation fuel type v burnt in season s during year y – from Equation (33)
$S(P_{v,s})$ = Standard error for patchiness factor for vegetation type v in season s – from section
p = Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA = Boundary type: Project Area
i = Fuel class (ie, fine, coarse, woody, shrubby)
g = Greenhouse gas
v = Eligible vegetation fuel type
y = Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s = Fire season: Early Dry Season or Late Dry Season

Finally, emissions from fires in year *y* is summed across greenhouse gas, vegetation type, and season. Errors are finally carried across all relevant computations here in equation (41):

$$S(E_{p,PA,f,y}) = \sqrt{\sum\nolimits_{g,v,s} S(E_{p,PA,f,g,v,y,s})^2} \tag{41}$$

Where:
$S(E_{p,PA,f,y})$ = Standard error of emissions in calculation period p within the Project Area from fires in year y
$S(E_{p,PA,f,g,v,y,s})$= Standard error of emissions in calculation period p within the Project Area from fires by greenhouse gas g, burnt in vegetation type v in year y during season s – from equation (40) above
p = Calculation period: Historical reference period (HRP) or Crediting Period (CP)
PA = Boundary type: Project Area
i = Fuel class (ie, fine, coarse, woody, shrubby)
g = Greenhouse gas
v = Eligible vegetation fuel type
y = Year 1, 2, 3, etc., of the calculation period and is taken to be a calendar year
s = Fire season: Early Dry Season or Late Dry Season

Ex-post monitoring adopts the same within-year propagation (Eqs. 26–38). Uncertainty is presented per calendar year and for multi-year means via Eq. (39); it is not aggregated linearly across years.

4. Estimating Uncertainty from Baseline Average

All steps described in the previous subsections must be run in their entirety for every year of the historical reference period. Once the standard error for emissions from fires in all years of the historical reference period has been calculated, the standard error of the baseline average is calculated using equation (42) below:

$$S(BE) = \frac{\sqrt{\sum_{y=1}^{n} S\left(E_{BP,PA,f,y}\right)^2}}{n} \quad (42)$$

$S(BE)$	=	Standard error of baseline emissions from the historical reference period
$S\left(E_{BP,PA,f,y}\right)$	=	Standard error of emissions in the Historical reference period within the Project Area from fires in year y – from equation (41)
BP	=	Calculation period: Historical reference period
PA	=	Boundary type: Project Area
y	=	year of historical reference period
n	=	length of historical reference period in years

Then set the relative uncertainty at 95% confidence as:

$$\mathbf{UNC}_{BE,CP1} = z_{0.975} \frac{S(BE)}{\overline{BE}_{HRP}} \quad (43)$$

where

- $z_{0.975} = 1.96$(normal assumption) and
- $\overline{BE}_{HRP}$ is the central estimate of the unadjusted HRP baseline

Presentation of uncertainty for the downward adjustment and BAU comparison.
For the first crediting year, the relative uncertainty of the ex-ante unadjusted baseline is derived from Eq. (39) and used in the uncertainty-based downward adjustment (Baseline Standard §7.1, Eq. (1) in the methodology).

For subsequent years, uncertainty is reported per year using Eqs. (26)–(38) and, where needed, as standard error of multi-year means using Eq. (39).

Because fire-behaviour determinants reset annually, uncertainty does not accumulate over time; thus, temporal increases in confidence (e.g., from improved EO accuracy or national Tier-2/3 factors) can be reflected without retroactive compounding.

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Document information

Version	*Date*	*Description*
SFM v2	*03/10/2025*	*Second draft following secretariat feedback*
0.2.0	19 August 2025	Revision to incorporate new sections and sub-sections in line with current standards; provide completion instructions, realign their sequence, and allow inclusion of explanatory notes.
01.0	18 December 2024	Initial publication of form template.

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