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by
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Background notes
As requested in letter of invitation to Dr David Garnett (CEO, Tropical Savannas Management CRC), these notes briefly address:

- background on the role of the Tropical Savannas CRC
- history of savanna burning
- options for mitigating the greenhouse gas emissions from savanna burning

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1. Role of Tropical Savannas Management CRC (TSCRC)

The TSCRC is primarily a public good CRC whose main research foci are to ensure that the vast area of the northern savannas (~1.9 M km^2, or a quarter of Australia) are managed sustainably to provide long-term benefits (economic, aesthetic, social and cultural) to those who use them, and maintain healthy ecological processes, biodiversity and habitat. The Tropical Savannas CRC was first established in 1996, and renewed in 2001. In 2006, the CRC failed to gain funding for its third-round CRC proposal. However, this year the Commonwealth has provided interim funding to enable the TSCRC Board to develop a new funding bid for the next round.

Given the pervasive extent and impact of fire (see following) in the northern savannas, the TSCRC has maintained a strong commitment to applied landscape management fire research throughout its tenure. This has included research programs focusing on fire and pastoral management, biodiversity management, and indigenous knowledge systems. Importantly, given the vast spatial scales of the fire-prone north, and associated very limited infrastructure and sparse population density, the TSCRC (together with its partner agencies) has played a major national role in the development of remote sensing (satellite-based) systems for daily monitoring and mapping of fire extent, and the development of simple-to-use web-based fire mapping information systems such as the North Australia Fire Information website (www.firenorth.org.au).

From 2000, the TSCRC has also supported a major initiative on improving estimates of greenhouse gas (GHG) emissions from savanna burning. This research has focused largely on the 28,000 km^2 West Arnhem Land Fire Abatement (WALFA) project area. Data collected through that program substantially informs the methodology of the National Greenhouse Gas Inventory (NGGI). Through that GHG emissions assessment program, the TSCRC and its research partners (including CSIRO, Bushfires NT, the former Australian Greenhouse Office [now DCC], and regional and peak body indigenous organisations [e.g. Northern Land Council—NLC; North Australia Indigenous Land & Sea Management Alliance—NAILSMA]) are acknowledged as international leaders in the field.

2. Savanna burning and GHG emissions from northern Australia

Contributions from savanna burning to Australia's NGGI amount to ~1-3% annually, depending on the magnitude of respective fire seasons. Recent assessment of the extent of burning derived from satellite imagery shows that, over the period 1997-2004, an average of approximately 370,000 km^2 (19%) of the 1.9 M km^2 tropical savannas was burnt annually, mostly under severe late dry season (Aug-Nov) conditions (Figure 1). This comprises ~70% of national fire extent over the same period. In annually reliable high rainfall (generally >900 mm) savanna regions, available fuel accumulation (mostly grass, litter) is sufficient to carry fire on an annual basis—human ignition patterns are the main drivers of recurrent fire extent. With declining rainfall, and associated decreasing annual reliability, antecedent rainfall accumulation over a number of growing seasons becomes increasingly important (Meyer 2004; Russell-Smith et al. 2007).

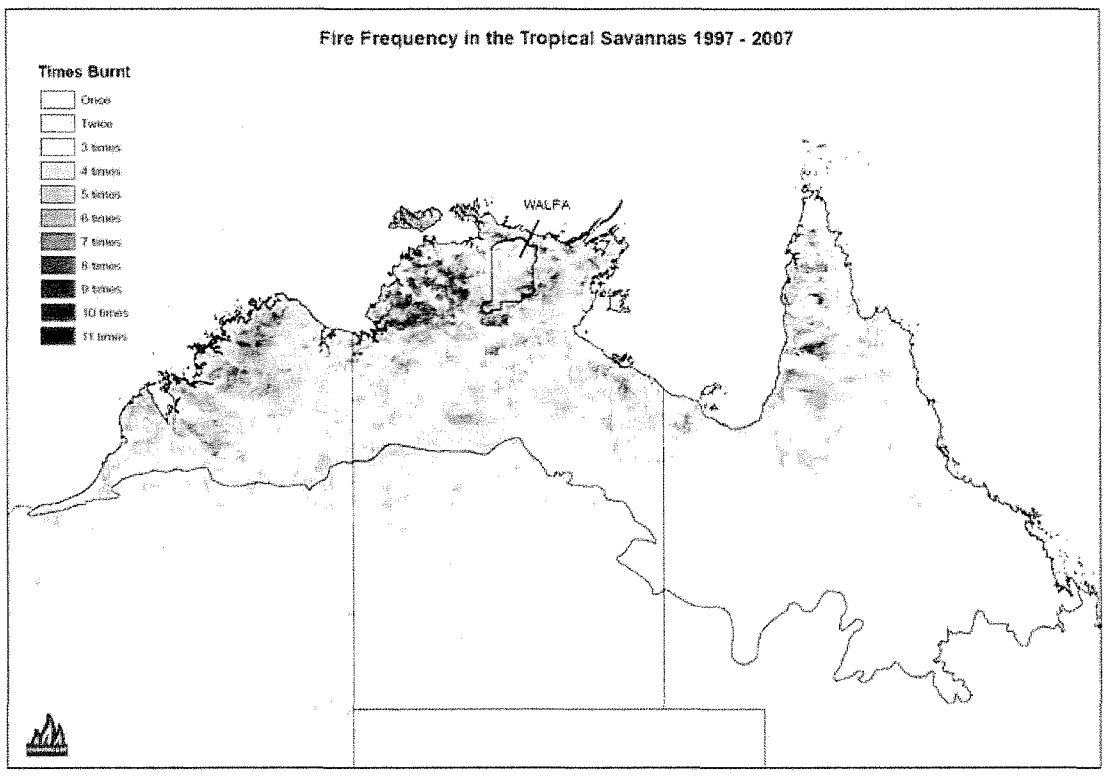

Figure 1: Fire frequency in the tropical savannas, with fire mapping derived from coarse resolution (~1 km^2 pixels) AVHRR imagery. Tropical savannas region north of line, derived from IBRA regionalisation.

The seasonality of savanna fire extent by jurisdiction is given below in Figure 2. These fire mapping data are derived from MODIS imagery (pixel size 250 m X 250 m), averaged for the period 2004-2007. The early dry season (EDS) is defined here as comprising the months Jan-July. The late dry season (LDS) comprises the months Aug-Dec. The figure clearly illustrates the current predominance of LDS fires across the savannas.

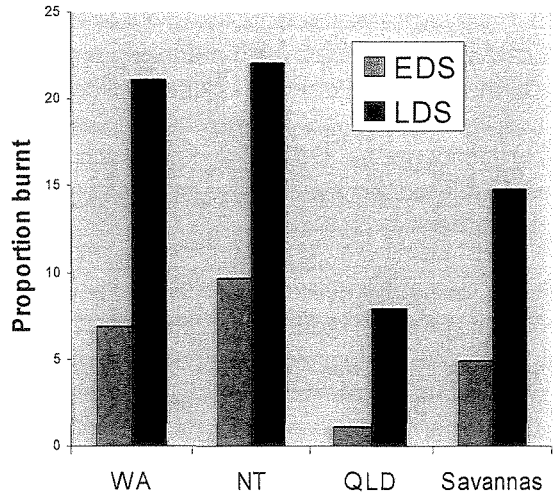

Figure 2: Seasonal extent of burning by jurisdiction, 2004-2007, for 1.9M km² tropical savannas region, derived from MODIS satellite imagery

Taking these same fire extent data, and applying the current NGGI GHG accounting methodology (AGO 2007) modified for seasonality based on data given in Russell-Smith *et al.* (2008), we can estimate that total GHG emissions for the four-year assessment period were 12.2 Mt CO_2-e, with ~80% contributed in the LDS period (Figure 3). More than half the GHG emissions from savanna burning emanate from the NT.

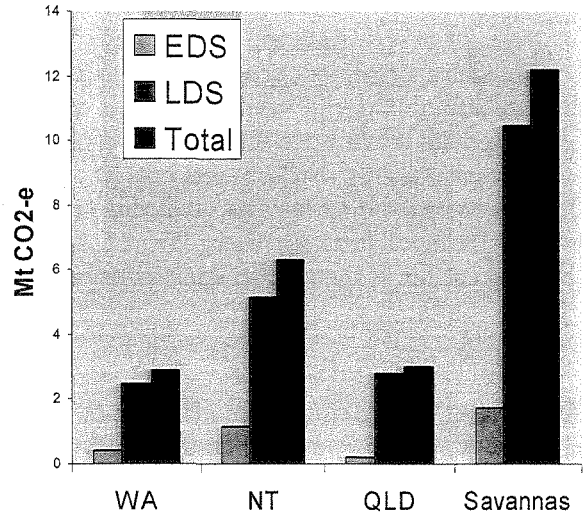

Figure 3: Seasonal extent of GHG emissions from savanna burning by jurisdiction, 2004-2007, for 1.9M km² tropical savannas region

2.1 GHG emissions from savanna burning

Fire is a dominant conservation and land management issue for the Australian tropical savannas. Reliable monsoonal (summer) rainfall and sustained high temperatures drive periods of rapid plant growth alternating with intense seasonal droughts of more than 6 months when no rain falls, evaporation rates are high and grasses cure rapidly. This regular annual cycle of several months of rapid fuel production, followed quickly by an equivalent or longer period of dry, often windy conditions that favour ignitions and fire spread, make the grassy savannas extraordinarily fire prone.

Carbon is removed from the atmosphere in rapidly growing grasses in the wet season and then much of it is released rapidly when oxidised by burning in the dry season. For the purposes of carbon accounting, the resultant annual pulse in emissions of carbon dioxide (CO_2) from burning is treated as being entirely re-captured in the next cycle of rapid growth. Savanna burning is assumed to cause no net CO_2 imbalance over timescales relevant to behaviour of the atmosphere. However, some other potent greenhouse gases (GHG) produced in biomass burning, including methane (CH_4) and nitrous oxide (N_20), have persistent effects, because equivalent volumes of these greenhouse-effective gases are not so directly returned to plants or otherwise removed rapidly from the atmosphere.

Fire intensities vary markedly with season, being relatively mild and spatially patchy early in the dry season, when air temperatures are relatively lower and fuels retain some moisture. Little coarser woody fuel is consumed in most early dry season fires. But fires burn more fiercely in the late dry season, when ambient air temperatures are higher and moisture levels lower. As a consequence, more coarse fuels are consumed. Large, smouldering stems produce much higher volumes of CH_4 and N_2O than do rapidly combusted fine, mostly grassy fuels. Studies in the region have shown that emissions of these potent greenhouse gases are relatively greater in late dry season fires than in early fires (Meyer 2004; Russell-Smith *et al.* 2008).

This seasonal variation in amounts and types of GHG production with timing of fire is critical, because it provides options to intervene in fire regimes in greenhouse-relevant ways. Strategic early burning helps reduce the total area and total biomass burnt, as well as the proportion of woody fuels burned, by reducing the incidence, rate of spread and extent of late dry season wildfires. Savanna fire abatement projects seek to reduce GHG emissions to the atmosphere over a specified time period, rather than to increase capture and storage (sequestration) outside the atmosphere. Partial decoupling of emissions and carbon storage occurs because fuel that is not consumed quickly by fire is removed by chiefly invertebrate consumers whose metabolic products are taken up by soils instead of being immediately released to the atmosphere (Cook 2008).

It is important to appreciate that a savanna fire abatement project differs substantially and essentially from forestry-style sequestration projects established under different provisions of the Kyoto Protocol. No sequestration is involved; rather, accredited abatement projects operate against a pre-project baseline. Emissions abatement may be achieved *annually* against that baseline, both through reduction in the overall area (hence amount of fuels burnt), and also by shifting the intensity / seasonality of burning (also reducing amount of fuels burnt) through the undertaking of strategic management practices (e.g. prescribed burning of strategic firebreaks; prescribed burning earlier in the year to implement more patchy, more low intensity fires).

2.2 Western Arnhem Land Fire Abatement model and accounting methodology

The Western Arnhem Land Fire Abatement (WALFA) project has been developed since 1996 to address chronic fire management problems in Aboriginal-owned, high biodiversity savanna landscapes of western Arnhem Land. In particular, the essential problem has involved extensive impact of annual wildfires occurring late in the seven month dry season period; over the ten-year pre-project baseline period (see below) the 28,000 km^2 WALFA region was burnt ~40% on average, with 32% of this annual average occurring in the late dry season. Nearly the entire amount of this burning has been attributable to human (anthropogenic) ignitions. In the case of WALFA, such fire management practice (burning throughout the year, typically under prescribed conditions) was undertaken extensively by Aboriginal people before societal collapse and associated abandonment of traditional practices with the advent of European settlement.

To reduce emissions of greenhouse gases, key objectives of the project have been to (a) substantially increase the extent of early season burning using strategically prescribed fires, so as (b) manage for and limit the extent of late season fires, and (c) thereby reduce overall both the area and amount of fuels which are burnt. In the three years of operation (2005-2007) of the project, WALFA partners have abated (reduced) GHG emissions by 420,000 t CO_2-e relative to the established ten-year project baseline (1995-

2004). Such figures translate to reduction of GHG emissions by 38% over the three years of project operation.

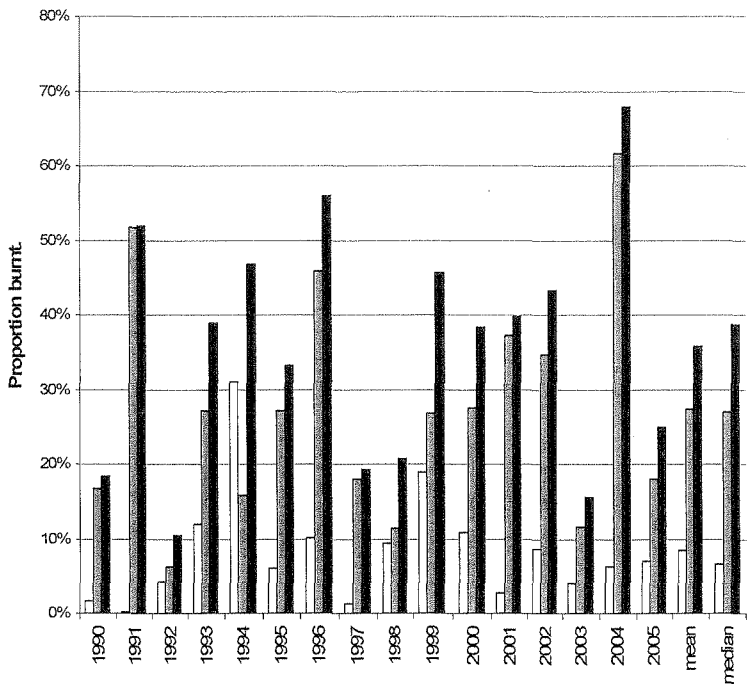

Fig. 4: Fire extent in the WALFA region 1990-2004, by season, where fire extent for early dry season (Apr-July) = clear bars, late dry season (Aug-Dec) = grey bars, annual = black bars. Mean and median values also shown.

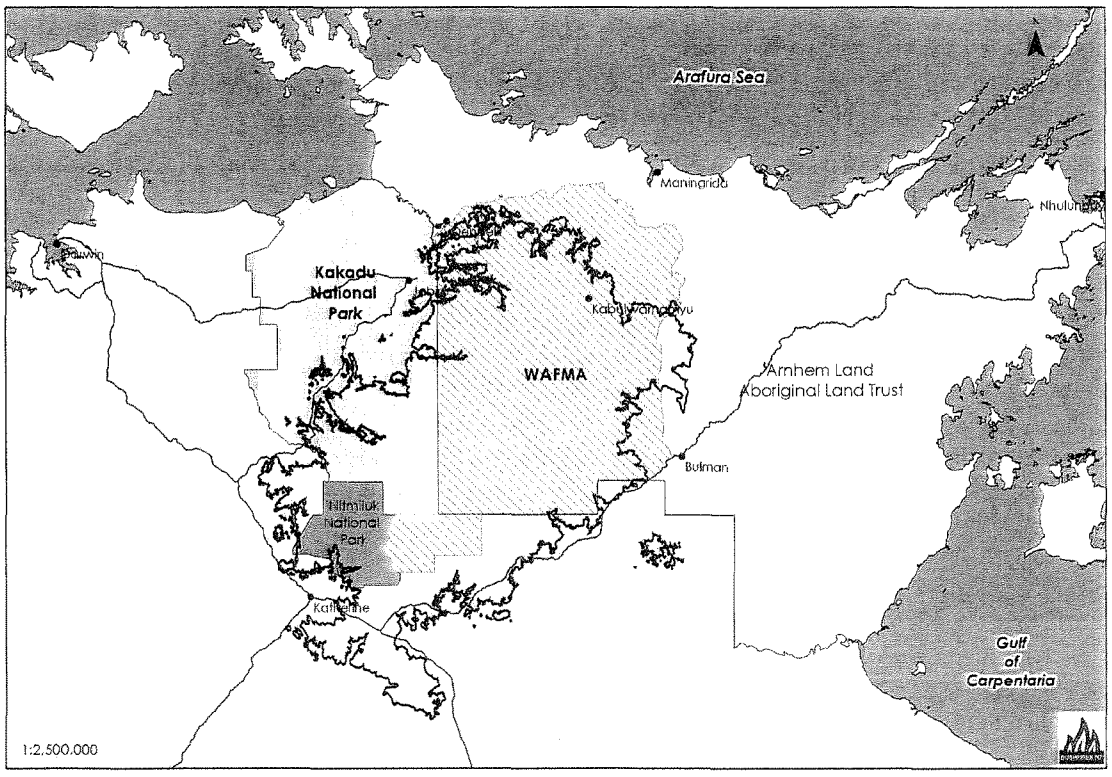

Fig. 5: Location of West Arnhem Fire Management project in relation to Kakadu and Nitmiluk National Parks, and Arnhem Land generally

These above figures are informed by a GHG accounting methodology developed by WALFA partners since 2000, derived substantially from accepted methodological procedures established under guidelines developed by the Intergovernmental Panel on Climate Change (IPCC 1997), and as incorporated in Australia's National Greenhouse Gas Inventory. In fact, earlier WALFA research results are incorporated directly into current NGGI methodology (Meyer 2004; AGO 2007). In brief, that methodology establishes annual GHG emissions from defined regions (e.g. the tropical savannas, QLD, individual properties or regions) as:

- the product of the area burnt (derived from satellite mapping of fire-scars, but typically at very coarse scale) X the assumed fuel load X a term which accounts for the amount of fuel actually consumed; and
- the product of the mass of fuel consumed (from the previous equation) X standard emission factors (concentrations) for CH_4 and N_2O from combusted fuels to estimate the amounts of GHGs emitted. Finally, the GHG potential of these two gases is converted to CO_2 equivalents using formulae based on the strength of their greenhouse activity and persistence in the atmosphere.

Research by WALFA partners has substantially refined that methodology, most significantly through the explicit incorporation of terms for fire seasonality and severity (Russell-Smith *et al.* 2004, 2008). That research establishes that, on average, GHG emissions from early season fires are slightly less than half those from late season wildfires. Other refinements have included (a) fine-scale (derived from Landsat satellite imagery) mapping of fire-scars, (b) fine-scale mapping of regional vegetation / fuel types, (c) detailed assessments of the accumulation of different fuel types (e.g. grass, litter, woody debris) with time-since-fire, (d) detailed assessments of fire patchiness and fuel combusted, with season and fire severity.

Importantly, the refined WALFA savanna burning methodology sets out a robust and reliable project-level GHG accounting framework which can be applied to other fire-prone savanna landscapes in relatively high rainfall areas of northern Australia. Specific project-level research tasks include:

- developing a fine-scale ten-year pre-project fire history baseline;
- developing refined vegetation / fuel type mapping;
- validating / refining fuel accumulation parameters for respective fuel types;
- validating / refining fire patchiness and combustion parameters for respective fuel types, with respect to season and fire severity; and
- assembling and integrating above data sets, along with pertinent emission factor parameters, within a relational GIS framework, for GHG monitoring and accounting purposes

2.3 New savanna burning emissions abatement opportunities

Building on the experience of WALFA, and under the Commonwealth Government's *Indigenous Economic Development Strategy* policy commitment to assist Indigenous people engage with and development carbon market opportunities, NAILSMA partners are in the process of developing four new landscape-scale emissions abatement projects in the north Kimberley, central Arnhem Land, Gulf region, and western Cape York. While the actual boundaries of these project regions are subject to ongoing discussion and negotiation, their current preliminary configurations are given in Figure 6. Each of these new project areas involves / concerns substantial Aboriginal land holdings and interests-in-land (e.g. resolved and unresolved Native Title claims).

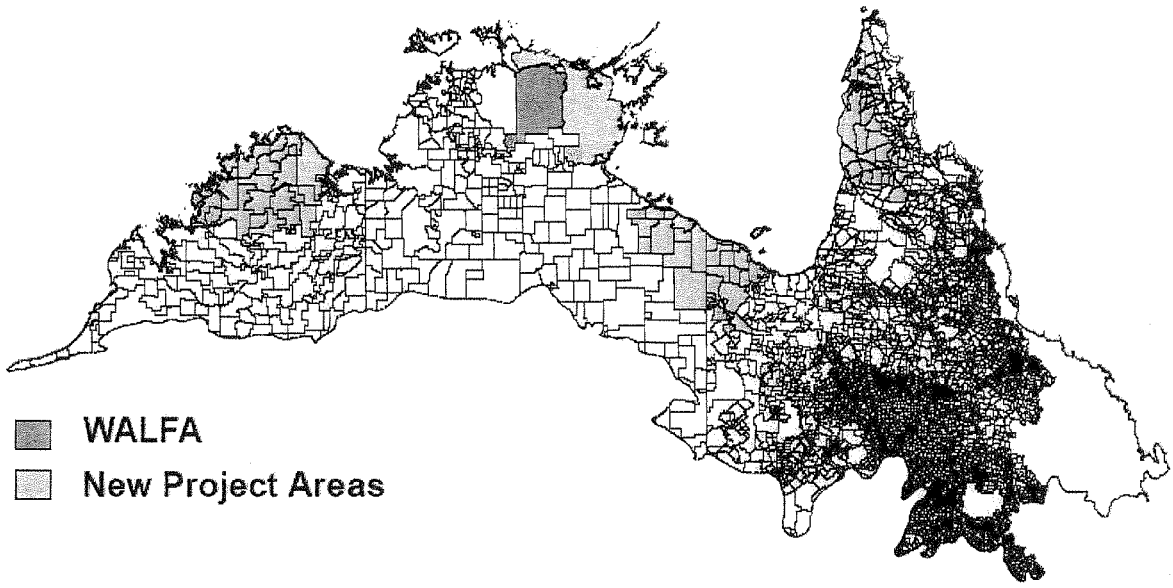

Figure 6: Location of new savanna burning emission abatement projects

3. Options for engagement of Indigenous fire managers with markets

The current Australian Government has signalled its intention to assist indigenous economic involvement in savanna burning opportunities in two policy initiatives:

3.1 Indigenous economic development strategy

Prior to the last Federal election, the Labor Party committed to supporting development of an "indigenous emissions trading program". That commitment included providing opportunities "for Indigenous participation in fledgling carbon markets by establishing the legal framework for creation of carbon credits for altered fire regimes and providing $10 million to build local capacity, build partnerships between the private sector and Indigenous communities, research its scientific and market potential and promote sales to growing national and international markets".[1] Subsequently, the Australian Government (principally through the Department of Environment, Water, Heritage & the Arts) has been negotiating with the North Australia Land & Sea Management Alliance (NAILSMA)[2] to implement an R&D program for addressing the above issues. Agreement for that program is likely to be finalised in the next month or so, and will likely include the following elements:

- ***establish a sustainable institutional foundation*** under the NAILSMA partnership for promoting culturally appropriate indigenous engagement with, and developing indigenous business opportunities arising from, emerging carbon and related markets specifically focusing on GHG emissions abatement from savanna burning
- ***coordinate and conduct research into aspects of policy, legal, marketing and governance frameworks*** which will inform both the active participation of indigenous stakeholders in emerging carbon-related opportunities, as well as providing a north Australian indigenous perspective in the development of state/territory, national and international carbon and GHG policy agendas
- with support from national (e.g. CSIRO), regional (e.g. Tropical Savannas Management Cooperative Research Centre) and state-based research institutions, ***coordinate and support the undertaking of key biophysical research activities required for developing robust savanna-scale monitoring and accounting frameworks***, particularly those involving remote sensing approaches for undertaking automated fire extent and severity mapping, and atmospheric emissions estimation
- in collaboration with regional indigenous partners and building on the commercial precedent established with the Western Arnhem Land Fire Abatement (WALFA) project, ***support project capacity building and research activities associated with the undertaking and formal accreditation of at least four new landscape-scale fire abatement projects,*** namely in fire-prone regions of western Cape York Peninsula, the NT-QLD border region of the Gulf of Carpentaria, central Arnhem Land, and north Kimberley
- ***coordinate and support the undertaking of allied socio-economic-cultural and biodiversity benchmarking activities*** associated with above regional projects, as means both for establishing robust monitoring criteria as well as developing complementary economic benefits (e.g. cultural and biodiversity credits; targeted institutional support)

3.2 Carbon Pollution Reduction Scheme (CPRS)

The Commonwealth has indicated that it is unlikely that emissions from savanna burning would ever be included in the CPRS along with other agriculture emissions, but, consistent with its *Indigenous economic development strategy* policy position (above), notes that "the Government will consult with indigenous land managers on this matter".[3] Elsewhere in the same document it notes that "[i]t would also be difficult to cover emissions from savanna burning because the complexity of property rights for Indigenous lands would make it difficult to identify single commercial entities that could take on scheme obligations for those emissions."[4]

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[1] Labor Party *Indigenous Economic Development Strategy* pre-election policy announcement of 5 October 2007, Joint Statement by Peter Garrett MP, Jenny Macklin MP, Warren Snowdon MP

[2] NAILSMA represents the land and sea management policy and research interests of the Balkanu Cape York Development Corporation (on behalf of Cape York Land Council), Carpentaria Land Council, Kimberley Land Council, and Northern Land Council

[3] Department of Climate Change 2008, Carbon Pollution Reduction Scheme Green Paper, p. 19

[4] Department of Climate Change 2008, Carbon Pollution Reduction Scheme Green Paper, p. 136.

From our understanding of the issues involved, the TSCRC considers that the latter statement concerning the prohibitive 'complexity of property rights' does not provide an accurate nor realistic appraisal of the governance issues surrounding savanna burning projects. For example, and as the WALFA example illustrates, it is eminently feasible for indigenous landowners from a large number of clans encompassed within the WALFA area to join together to form a common governance arrangement. While that arrangement is not yet incorporated at the present time, there is no impediment for this to occur in the future if and when the land owning parties wish to do so.

More importantly, and given that as indicated in previous discussion we have noted that emissions abatement projects differ fundamentally from sequestration projects in that abatement is achieved against a pre-project reference baseline, there is no obvious impediment for landowners and landholders across a range of tenures (e.g. pastoral, indigenous, government lands) to combine together to manage fires for GHG emissions abatement by forming governance arrangements suited to that purpose. In fact, emissions abatement projects can effectively only be undertaken as cooperative fire management partnerships at larger regional scales to reduce or spread the risk of undesirable outcomes, whereby one or more tenures may experience a bad fire season whereas the partnership as a whole remains in credit.

As such, we consider that concerns about indigenous tenure arrangements should not be over-emphasised. Rather, considerations need to be substantially broadened to seek general contributions to (a) governance practice for regional partnerships, (b) multi-tenure arrangements covering both Indigenous and non-Indigenous stakeholders. Not only would such partnerships still achieve the desired economic, social and cultural outcomes for Indigenous communities, but they would accrue tangible benefits for regional communities as a whole. Moreover, governance models developed for fire will have application to many other issues in regional development and conservation.

3.3 Policy options

In light of the above discussion, we are finally then able to pass comment on various possible policy options concerning the positioning of savanna burning with reference to the CPRS. Following is presented a slightly edited summary of such an assessment submitted by NAILSMA to the Garnaut Climate Change Review[5]:

"It is concluded that:
Option 1: Direct coverage of fire-related emissions under the CPRS—practically unworkable given (a) huge transaction costs involved with accounting, regulating and attributing responsibility for, hundreds of thousands of ignitions, (b) most of which are likely to be for legitimate non-commercial purposes (e.g. customary Indigenous responsibilities, conservation, property protection)

Option 2: Direct coverage but with special conditions for Indigenous fire users—practically unworkable as above; also discriminatory, and mitigating against the formation of broader community partnerships required for managing fires at landscape scales

Option 3: Savanna burning outside the CPRS, but with the option to trade well-accredited emission credits with covered sectors—practically viable, encouraging development of landscape-scale fire management enterprises and partnerships, providing economic incentive for emissions abatement, and tied directly to national emissions reduction targets. Potential drawback might be convincing international community of legitimacy of approach

Option 4: Savanna burning outside the CPRS and credits not acceptable under the CPRS, but well-accredited projects operating in voluntary markets—practically viable as for Option 3, but not tied to national emissions reduction targets

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[5] *Savanna Burning, Greenhouse Gas Emissions Abatement, and Indigenous Economic Development Opportunities for Remote Communities across Northern Australia.* Draft submission to the Garnaut Climate Change Review, developed by the North Australia Indigenous Land & Sea Management Alliance (NAILSMA)

Option 5: No trading, but direct support of fire management activity to meet emission reduction targets—practically viable under current Commonwealth policy for supporting Indigenous land management initiatives, but not mainstream, and not supporting Indigenous economic development"

3.4 Summary and conclusions

Through extensive work already done, we have:

(1) resolved the technical challenges of reliably measuring emissions and designing management interventions to reduce them;
(2) designed and obtained support for ongoing refinement of accuracy and precision of measurements;
(3) shown that regional collaborations are not only plausible but highly productive;
(4) identified the remaining challenges involved in building robust regional governance arrangements and reached agreement to test models in a number of contexts.

Improved fire management is a key issue for sustainable development in northern Australia. Improvement is achievable through regional collaborations that generate multiple social and environmental benefits that draw financial support from emerging carbon markets. Arguably the most important remaining challenges are to ensure that Australia's domestic policy and positions taken to post-Kyoto negotiations do not compromise, but instead support these opportunities.

In most respects, the Green Paper puts a coherent and apparently well-considered position on treatment of savanna fire. That important progress should not be compromised by an unnecessary over-emphasis on issues associated with Indigenous tenures and associated rights. WALFA has demonstrated the contemporary efficacy of regional-scale collaborations that characterised Indigenous fire management in the past, and can provide a model for wider collaboration in the future.

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