The 'how-to' of firebreaks and aerial burns

Practical advice from the Bushfires Council, NT

Tim McGuffog, Bushfires Council, Northern Territory *Article first published in 2001*

Firebreaks or fire access trails may be either natural or man-made. Natural breaks include streams, rivers and other wet areas where fire won't burn or areas that are naturally devoid of fuels, such as rocky outcrops or recently burnt areas.

Man-made firebreaks are usually a strip of land where vegetation has been partially or completely removed for the purpose of controlling fires. They can be constructed by numerous methods including grading, disc harrowing, rotary hoeing, flattening, slashing, chemical poisoning, burning or a combination of two or more as listed. Some constraints in using or establishing firebreaks include soil erosion, opening up of country for trespassers, clearing sacred sites, availability of machinery, government regulations, and cost.

A good fire-break with the vegetation removed (mineral earth).

A neglected firebreak (too much vegetation present on the soil)

Installing firebreaks

Planning new firebreaks should be considered as part of a total land-management package and address matters such as topography, soil type, roads, rivers or other areas in which to tie firebreaks, sacred sites and other Aboriginal interests, present or planned paddocks and other projected future land use. Primary consideration must be given to soil conservation.

Land subdivision is often conducted in rectangular lots that do not take into account topography and accordingly it will remain the norm for fences (that need protection from fire) to be built in unsuitable locations, so compromise is required. A planned and properly constructed firebreak can be just as effective and economic in the long term by using alternate measures such as flattening, poisoning or slashing, followed by burning.

There are no hard and fast rules that can be applied across the board. In an ideal situation firebreaks would follow ridges and be wide enough so that loose material is never graded into the tree line. In practice many firebreaks are going to be sited in areas where a compromise between ideal location from a soil conservation point of view, fencing requirements, practicability and cost have been taken into account.

Ways to minimise soil erosion

Whenever vegetation is disturbed some soil erosion will occur. The aim of installing good firebreaks is to minimise erosion. The best way to achieve this is to prevent water channelling. Do this by:

- **Avoid 'windrows' or 'rills'**

These occur when soil builds up along the edge of the firebreak as a result of grading. Running the final cut out by simply lifting the blade to ground level and spreading the windrow will generally level out the soil. Usually the vegetation from the windrow will rot down or blow away within a short period of time and when the firebreak traverses a hill this will allow as close as possible for the natural sheet run off of water.

- **Use banks or 'whoa-boys'**

Potential problems can occur when firebreaks run up and down hills, and across waterways. These problems can be alleviated by the use of banks or whoa boys. Mounds of soil are built up across the firebreak and appear similar to speed-humps across roads. This is a fairly straightforward procedure where the grader operator turns his blade to a bulldozing position and carries enough material to create a bank of a minimum height of 400 mm. The length of these banks should be double the width of the firebreak. Whoa-boys must always be installed on the banks of creeks.

Firebreaks that will not have to serve as roads can have fairly narrow whoa boys constructed, needing only to be around 500 mm wide. If the firebreak is used for regular access they will need to be much wider. For an approximate guide, whoa-boys are required when the slope exceeds one degree. At this slope, one every 150 m or so should suffice, and this should be closed up at the rate of 20 m for every degree of increase of slope.

Firebreaks used as roads

If the firebreak is to be used as a road, where a constant driving speed is desirable, it can be flat-bladed on level country, but needs to be formed with appropriate drain-


Helicopter with incendiary equipment

age facilities installed on undulating country. An acceptable alternative would be to grade either one or two-blade firebreaks at the onset of the dry season, then return before the onset of the wet and throw the windrow back across the firebreak.

For new firebreaks, a minimum width of three bulldozed blades is recommended. Grading should consist of a light cut on both sides bringing the windrow to the middle. This windrow should then be straight bladed and whoa boys installed.

First annual grading should be a cut to mineral earth (i.e. all vegetation removed) from one side then the windrow run out. The following year the first cut is taken from the opposite side then run out. The integrity of whoa boys should be maintained. By following this procedure loose material is never run into the tree line and sucker growth is removed every second year.

Combined firebreak/fence lines

For effective combined firebreak/fence lines the minimum width is four blades, although five is preferable. This gives the option of allowing the fence to be positioned in more than one location.

Options are:

- Position fence in the middle, which allows for grading both sides either annually or in alternate years. If considering grading each side in alternate years it must be remembered that this means suckers may have four years growth between grading.
- Position fence one and a half blades from down wind side, or in the case of a bush/paddock area, on the paddock side. This will allow for a better firebreak to protect the fence and/or help discourage herd from knocking down whoa boys by establishing 'cattle camps' along the fence line.

By using this system the narrow side need only be graded, slashed or poisoned periodically to control sucker growth.

Common problems

For periodic maintenance care must be taken by operators to avoid creating channels which can encourage soil erosion. Some potentially hazardous situations are:

- **Grading too fast**

This has led to bouncing of the grader, which in turn creates a herring-bone effect on the firebreak. This is not a problem when the 'V's' point up the hill, as it tends to disperse the water in an even pattern. However, when the 'V's' point downhill, this tends to form a channel down the centre of the firebreak.

- **Windrows**

Even when using the system described above, the windrow that has been run out still forms a wide shallow windrow that is not apparent when covered with vegetation. For this reason records should be kept as to which way the windrow was run out so as to ensure it is done the opposite way every year. The windrow should never be run into the tree line or under fences. This results in soil loss that becomes impossible to recover without expenditure on grading equipment, and is therefore uneconomical in the long-term.

- **Digging the 'toe' in**

Often inexperienced operators will dig the toe of the blade on the second cut, creating a channel in the centre of the firebreak. If the system of simply spreading the windrow is used for the second cut, the blade does not need to penetrate the natural ground level at all.

- **Lack of drainage control**

This situation may be bought about by all of the above mentioned faults, plus not rebuilding whoa boys, blocking drains or realigning the firebreak in an unsuitable position.

Alternative methods

- **Disc harrows**

Depending on frequency of harrowing and the power of the tractor, more than one cut may be required to bring a firebreak to an acceptable standard. Disc harrows do not create as many problems as grading, provided they are not used during heavy rainfall. Some care should be taken to use contour ploughing where it is practical. However, unless working on steep slopes, make sure the seed bank held across the firebreak is sufficient to ensure early regrowth before torrential rains occur.

- **Slashing**

If done on a regular basis slashers (especially twin blade) will disperse material over a wide enough area. When slashing in heavy grass to create an effective break, the trash must be removed. This may be achieved by raking, making several passes with the slasher to ensure the cuttings are taken to one side, or burning.

While some people discourage burning, it is the sole method that removes all flammable material and makes a true firebreak (until such time as regrowth occurs). Removing trash only reduces the flame height.

- **Chemical firebreaks**

The use of chemicals is gradually becoming a viable option to establish firebreaks. This method can be cheaper compared to mechanical means.

The types of equipment currently available to land

managers for applying chemicals are diverse in design and arrangement. A useful version that is currently being adopted is a high-pressure pump discharging through a boom-less nozzle. This nozzle can effect up to a 19-metre swathe width at a single pass. This equipment is available through local suppliers and at affordable prices to land managers. The apparatus can be mounted on a trailer and towed by a quad bike through inaccessible and often wet areas, where heavy machinery cannot gain access.

One specific advantage of using this nozzle and unit is that a chemical firebreak can be installed off line so that land managers are not restricted to installing firebreaks in areas that must be accessible to graders, dozers, or ploughs.

On common boundaries between properties, firebreaks can be installed from the one side (through fences and timber) thus reducing the time and resources required to create firebreaks by traditional means.

Other benefits associated with this methodology include:

- Less soil disturbance;
- Cheaper firebreak establishment;
- Wider firebreaks;
- Fewer people required to carry out operation;
- Firebreaks can be created in wet times and burnt off before adjacent areas are cured sufficiently to carry a fire i.e. fewer personnel required to undertake hazard reduction activities.

Having alternative options available to land managers to establish firebreaks will ultimately increase awareness towards fire management and allow greater control of fire through the advent of wider firebreaks.

Flattening

This can be achieved by several methods.

1. **Custom-built rollers:** these are extremely effective as they break the grass into short segments, encouraging rapid curing. This allows a strip (annual spear grass, *Sorghum intrans* in particular) to be burnt in safety as the surrounding vegetation is still green. This method is not especially effective on black spear grass, pennisetum and other similar grasses.
2. **Tyre flatteners:** usually purpose-built, however single large earthmoving tyres will suffice. This is only really effective with tall annual grasses (extremely effective for *Sorghum intrans*). Pennisetum, black spear grass and similar grasses usually stand up again as soon as the tyres pass over. A cheaper and similarly effective method is to cut a tree down and use it as a drag. This system is only effective when follow up burning is conducted.

Acceptable firebreak standards

Listed below are the options with notes on required standards for each.

1. **Ploughing:** Mineral earth type with trash (fuel) turned under. The number of times an area is ploughed will depend on the original fuel loading.
2. **Grading:** Mineral earth.
3. **Chemical Spraying:** Firebreaks that are sprayed still require the removal of the fuel. Raking or burning can achieve this. It is advisable to recommend only chemicals with a non-residue affect, such as Glyphosate or Roundup. Stay away from soil sterilants. Mineral earth standard.
4. **Rolling:** The rolling of firebreaks is a season-oriented practice. Rollers flatten the fuel but do not remove it. The removal of fuel (grass) will need to be undertaken by one of the other methods listed. If rolling is carried out under optimum conditions, that is, when the curing rate and the fire danger rating are low, the most practical way to remove the rolled fuel is to burn it. Under favourable conditions the fire is unlikely to spread away from the rolled area. Mineral earth standard.
5. **Slashing:** Slashing of firebreaks is probably the most preferred option for the small landholders. When firebreaks are slashed the slash (trash) must be removed. This can be carried out by one of the other methods listed. Again, under optimum conditions the most practical way of removing this slash is to burn it. The standard for slashed firebreaks is a minimum fuel height of between 25–20mm, with the slash removed. Before a slashed firebreak can be accepted, surrounding conditions must be taken into account. e.g: Status of fuel loadings immediately adjacent to the firebreak, size of the property (house block or larger) and land usage (orchard, hay paddock).
6. **Mowing:** The same conditions apply as for slashing.
7. **Raking:** Depending on the type of machine used to carry out the raking operation, this method of establishing a firebreak is more suited to being combined with slashing, mowing or chemical spraying. Standard as per other methods.
8. **Burning:** Preferred option for the larger properties. Establishing burnt firebreaks (buffer zones) are best used as part of a Prescribed Program such as the ACB program (Aerial Controlled Burning) or a Controlled Burning Program within a Volunteer Brigade area. The use of burning as a means of establishing firebreaks is subject to the restrictions as imposed by the *Northern Territory Bushfires Act*.

Aerial ignition

Aerial ignition using incendiary devices dropped from a helicopter may be used to initiate controlled burning of grass and undergrowth. This operation involves the injection of a capsule or ball containing potassium permanganate with a quantity of ethylene glycol immediately prior to ejection from the aircraft. Spontaneous combustion occurs within 30–40 seconds from injection allowing the incendiary time to reach the ground before ignition.

Dropping approval

- The operations must be authorised by the responsible landowner, manager, or agent for the land, which is to be ignited. The operation may be conducted under the supervision of a person from the relevant authority or land managers. This person is known as

the supervising officer.

- The person conducting the incendiary injection operation is known as the incendiary dispatcher and may also be the supervising officer.

Equipment requirements

- Equipment or apparatus for the purpose of dispensing incendiaries shall not be carried in or on a company helicopter unless an appropriate supplement to the flight manual for that helicopter has been approved and the helicopter is operated in accordance with the procedures and limitations contained therein.
- The incendiary device and equipment used to prime and dispatch the incendiaries, is subject to air-worthiness approvals by the Civil Aviation Safety Authority (CASA). This includes the use of automatic and manual priming devices and their components and also includes specifications for mounting in the aircraft.
- Manual injection operations shall use approved drop tubes, injector guns fitted with approved incendiary locator, and carry the following safety equipment readily accessible to the dispatcher:
    - Two water extinguishers of a type accepted by the Air Safety Officer
    - One BCF or CO_2 fire extinguisher.
    - One flame-proof fire blanket
- Plastic bags containing incendiaries carried in the helicopter must be kept in approved flame-resistant bags until the devices are loaded into the helicopter, or primed as required at the dropping area.
- The boxes or plastic bags containing incendiaries must always be securely fastened to avoid the contents falling loose.
- Ethylene glycol is to be carried in a non-crushable container, externally on the litter of the helicopter. A hose secured so as not to be a hazard in flight, from the glycol container to the incendiary injecting gun, then enables the injection of the incendiaries over the funnel of the drop tube. Glycol may also be carried in a storage container, which is part of an approved automatic incendiary priming machine.

Pilot and crew requirements

- For the dropping of incendiaries to initiate controlled burning, the pilot in command has to hold a commercial pilot's license with an Agricultural Rating and have at least 250 hours in command on helicopters, or have completed training specified in CAO 29.10 App. I Par 1, and certification in accordance with CAO 29.10 App. II Par 1 (Mustering and low-flying permission). Contract requirements may specify additional hours of experience or hours on aircraft type.
- The pilot in command shall ensure that he/she is fully familiar with all aspects of the operation and the incendiary dispensing equipment.
- The dispatcher shall be trained to the satisfaction of the pilot in command in all aspects pertaining to the dropping of incendiaries including equipment malfunctions and emergency procedures. The dispatcher shall also be trained in the correct procedures for working safely in and around the aircraft.

Pre-flight requirements

- The incendiary-dropping site shall be specified and clearly defined by the supervising officer using maps, GPS coordinates, terrain features, ground signals, and markers.
- Before beginning sorties, the pilot in command shall be personally briefed by the supervising officer on the location of the dropping area and on any other matters associated with the ignition of the area. The supervising officer shall ensure that the area to be ignited is free of persons or stock to the best of their ability.
- Prior to each day flying, the incendiary dispensing device must be ground-tested for correct operation by the dispatcher under the direct supervision of the pilot in command.
- The incendiary drop tube must be empty of incendiary devices during take-off and landing, and should be thoroughly cleaned along with ancillary equipment at the completion of each day's program.
- Prior to beginning the flight, the pilot in command will ensure that those persons to be carried are fully briefed, particularly on the action to be taken in the event of an on-board fire and the location and operation of the portable fire extinguishers.
- The pilot shall ensure that the movement of articles or persons at any time during flight will not result in any change in the helicopter's trim that could cause an unsafe condition and that the helicopter's centre of gravity will not move outside permissible limits.

In-flight requirements

- The pilot in command shall locate the ignition site and shall obtain confirmation from the supervising officer that the area has been correctly identified.
- Incendiaries shall not be dropped on a site unless the resulting fire is of no danger to persons or stock.
- When in the dropping area, the pilot in command shall at all times be in radio communication with the supervising officer.
- An operating height of not less than 500 feet will normally apply. Where flight below 500 feet is necessary, the helicopter shall not be flown below a height of 100 feet above the terrain and not within 600 metres horizontally of an occupied building **except** with the express permission of the occupier.
- ***Not*** **below a height of 100 feet above any person or occupied vehicle**
- ***Not*** **over any populous area at a height lower than 1000 feet above terrain.**
- Dropping operations shall only be conducted in accordance with the Visual Flight Rules.
- All injection operations shall be carried out over the

centre of the funnel opening.

- At the end of each operation the helicopter shall be cleaned to ensure that any loose articles are stowed. Any potassium permanganate or ethylene glycol that may have spilt must be cleaned up so as to avoid the inadvertent mixing of any spilt portions.
- Effective communication shall be maintained between the pilot in command and the dispatcher during operations and the dropping of incendiaries shall only commence on a signal from the pilot.
- The helicopter shall be flown in balanced flight while the incendiaries are being dropped.
- Dropping speed should not be below 40 knots and provision for emergency auto-rotation must be constantly in mind.
- All dropping runs shall be made on a crosswind or upwind heading to avoid flying through areas of heat induced turbulence or reduced visibility due to smoke.
- Operation over areas already ignited is prohibited below 500 feet above ground level.
- All occupants of the aircraft must be adequately restrained at all times by an approved safety harness whilst in flight.
- Only persons involved in the operation or in training shall be permitted on-board the aircraft during operations.
- The pilot in command of an aircraft may suspend or terminate an aerial ignition fight at any time in the interests of safety.

Emergency procedures

In the event of an accident or emergency, the pilot will advise the dispatcher, and other crew of actions to be taken. This may include:

- Discarding any primed capsule from the drop tube;
- Secure the injection gun;
- Close and jettison capsule bag;
- Assume crash position and prepare for evacuating the aircraft.

Chief pilot responsibilities

The chief pilot shall ensure that all pilots in command of helicopters conducting these operations are suitably qualified, conversant with, and operate in accordance with the instructions contained in this permit.

Air operators certificate holder: responsibilities

The Air Operators Certificate Holder shall ensure compliance with the above requirements.

For more information about land-management issues in northern Australia, go to the Savanna Explorer section of our website at http://savanna.cdu.edu.au/

For more information about the Centre's extensive research program go to our research section.