Fighting Fires

By Allan Layton and
David & Debbie Hibbert

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By David & Debbie Hibbert
and Allan Layton

This free eBook is a basic tool for the education of children. It illustrates some of the techniques and machinery used to prevent, manage and stop fires.

This is not a comprehensive resource and serves only as a general guide. New information and resources will be added in future updates.

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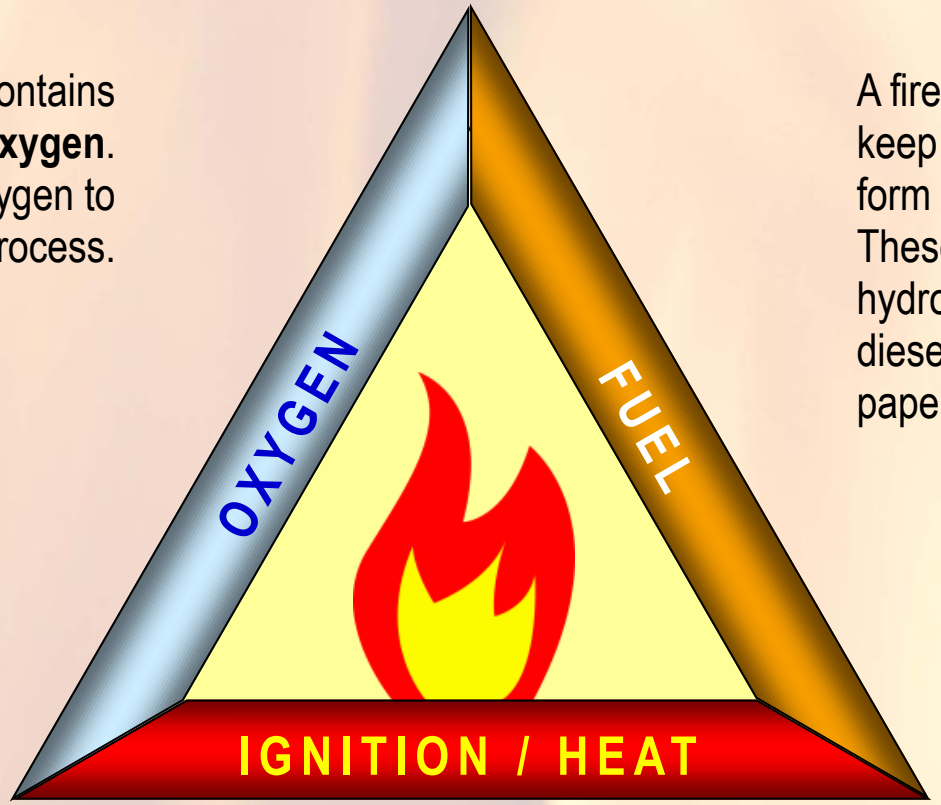
WHAT IS FIRE?

Fire is the process of burning, in which fuel/fuels combine chemically with oxygen, producing light, heat and gases including smoke.

FIRE TRIANGLE

Normal air at sea level contains around 21 percent **oxygen**. This is enough oxygen to support the burning process.



A fire needs **fuel** to start and to keep burning. Fuels can be in the form of gases, liquids and solids. These can include: natural gas, hydrogen, propane, butane, petrol, diesel, paint, oil, wood, grass, paper, plastic, wax, cloth and coal.

A fire needs an **ignition** or **heat** source. This can include: open flame, hot surfaces, sparks, friction and chemical reaction.

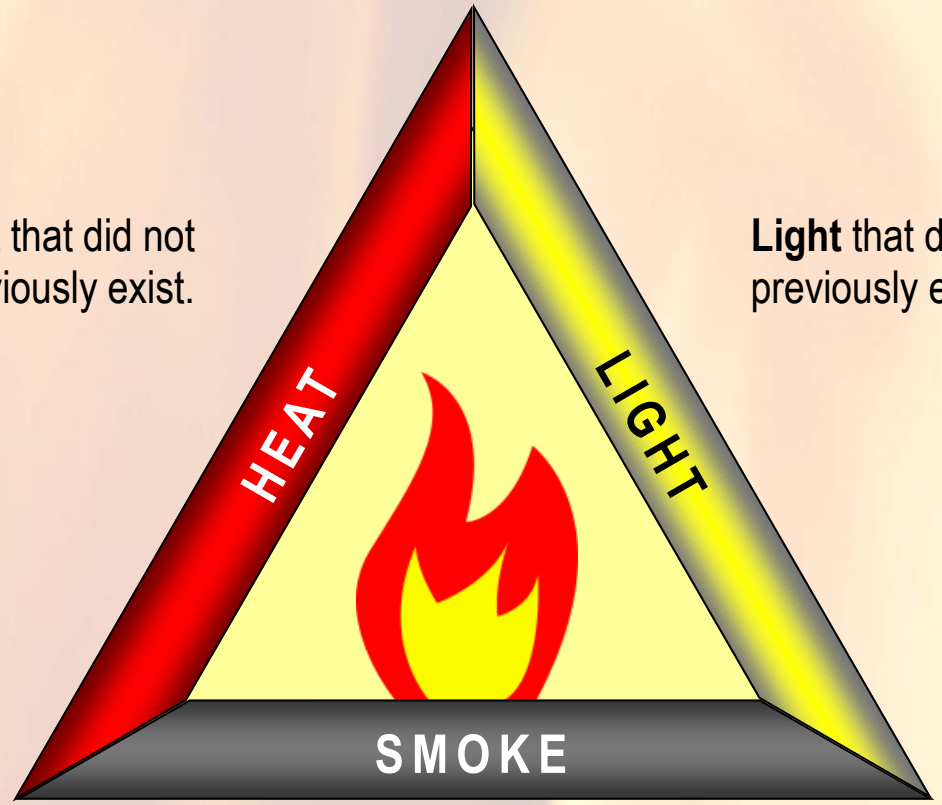
WHAT DOES FIRE PRODUCE?

Fire produces heat, light and smoke.

OUTPUT TRIANGLE

Heat that did not previously exist.

Light that did not previously exist.



Smoke that did not previously exist.

Smoke from bushfires is generally made up from particles of ash, gases and moisture, and is often called an emission

CAN FIRE BE USED FOR GOOD?

Yes, if fire is controlled, it can be used for good.

Can you think of some good uses of fire?

HEAT FOR WARMTH

Controlled

fire can produce useful

heat, light and smoke

LIGHT FOR SEEING

Public Domain Image

SMOKE FOR SMOKING FOOD

WHAT HAPPENS IF FIRE IS NOT CONTROLLED?

If fire is not controlled, it can be very dangerous and damage objects and the environment

What problems can fire cause?

Vehicle dAMAGE

Early painting from the 1800s - Public Domain

Uncontrolled

fire can produce damaging

heat, light and smoke

IS SMOKE A SOLID, LIQUID OR GAS?

Smoke is a gas.

Fire produces gases such as smoke, carbon monoxide and carbon dioxide. Gases can be deadly to humans and some gases produced by fire can be colourless, and odourless, making them impossible to see or smell.

HOW DID PEOPLE FIGHT FIRES 100 YEARS AGO?

Fighting bushfires in the past was often performed with buckets, brooms, wet materials and branches. This was inefficient and very dangerous.

Early Bushfire Fighting

Early painting from the 1800s - Public Domain

Fighting building fires in the past was often performed with buckets and very simple pumps. Ladders were often used to save people from burning buildings.

Early Metropolitan Fire Fighting

Magic Lantern Slide from the 1840s - Courtesy Bill & Joan Walsh

HOW DO WE FIGHT FIRES NOW?

Fighting fires today involves advanced techniques. This includes specialised vehicles and aircraft, machinery, radio communications, the greater use of information, better education and mopping up plans.

MODERN FIRE FIGHTING

Equipment

Preparation

Fuel Reduction Burns

Fire Towers

Fighting Fires

Mopping Up

Breathing apparatus is just one example of modern and safe fire fighting equipment used by current day volunteers and paid firefighters to help save life and protect property.

Safety Briefing Before A Controlled Fuel Reduction Burn

Country Fire Authority (CFA) and Department Environment, Lands, Water & Primary Industries (DELWP) fire-fighters are receiving a safety briefing prior to commencing a (controlled) fuel reduction burn.

Controlled Fuel Reduction Burn

Country Fire Authority (CFA) conducting a (controlled) fuel reduction burn.

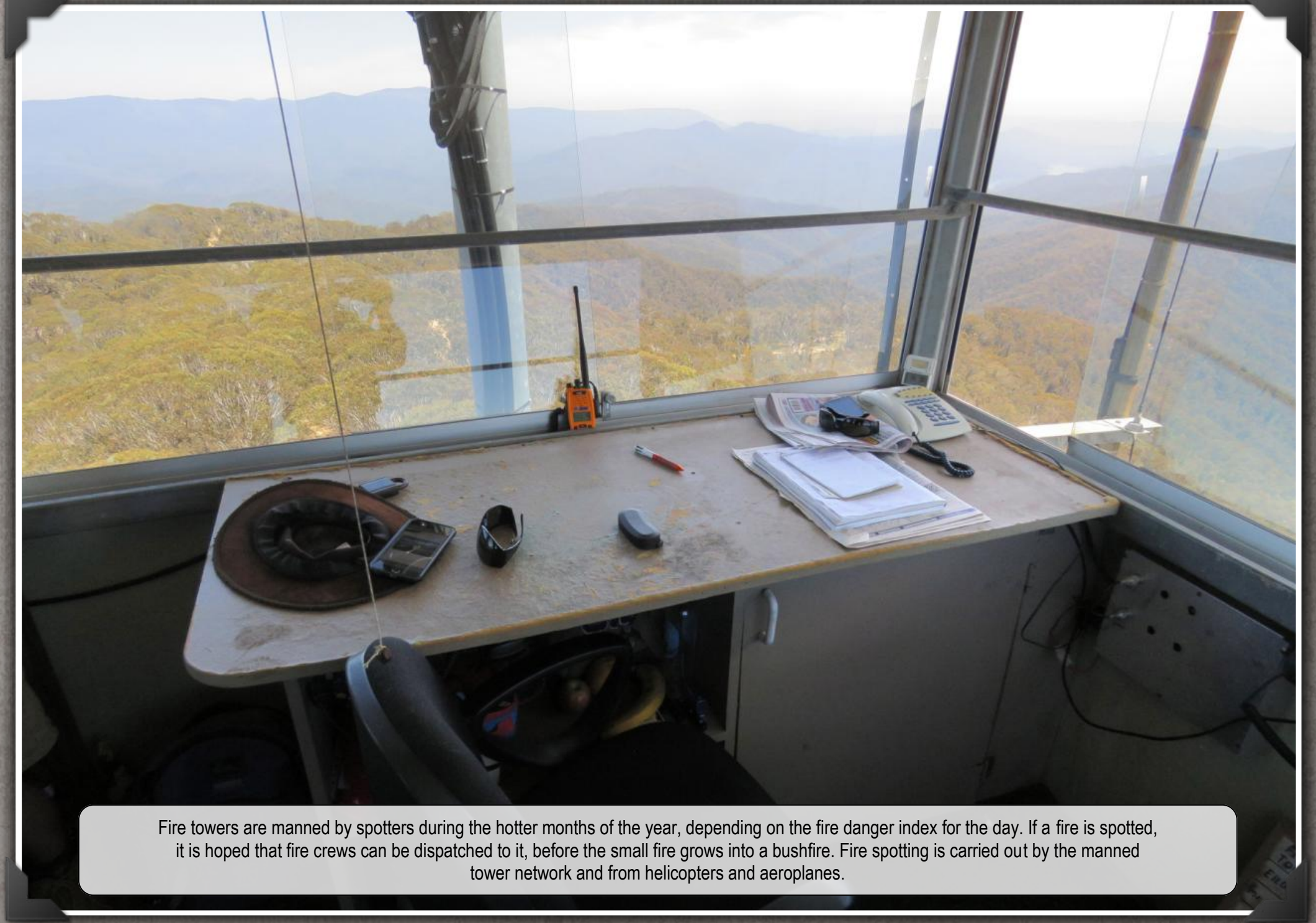
Fuel Reduction Burn (Previously called burning off)

A 'fuel reduction burn' in Autumn to remove litter such as twigs and leaves on the forest floor. Reducing litter helps lessen the chance of a more damaging fire developing later. Other fire reduction methods include slashing long grass or clearing an area of all burnable materials by making firebreaks.

Fuel Reduction Burn at Marysville

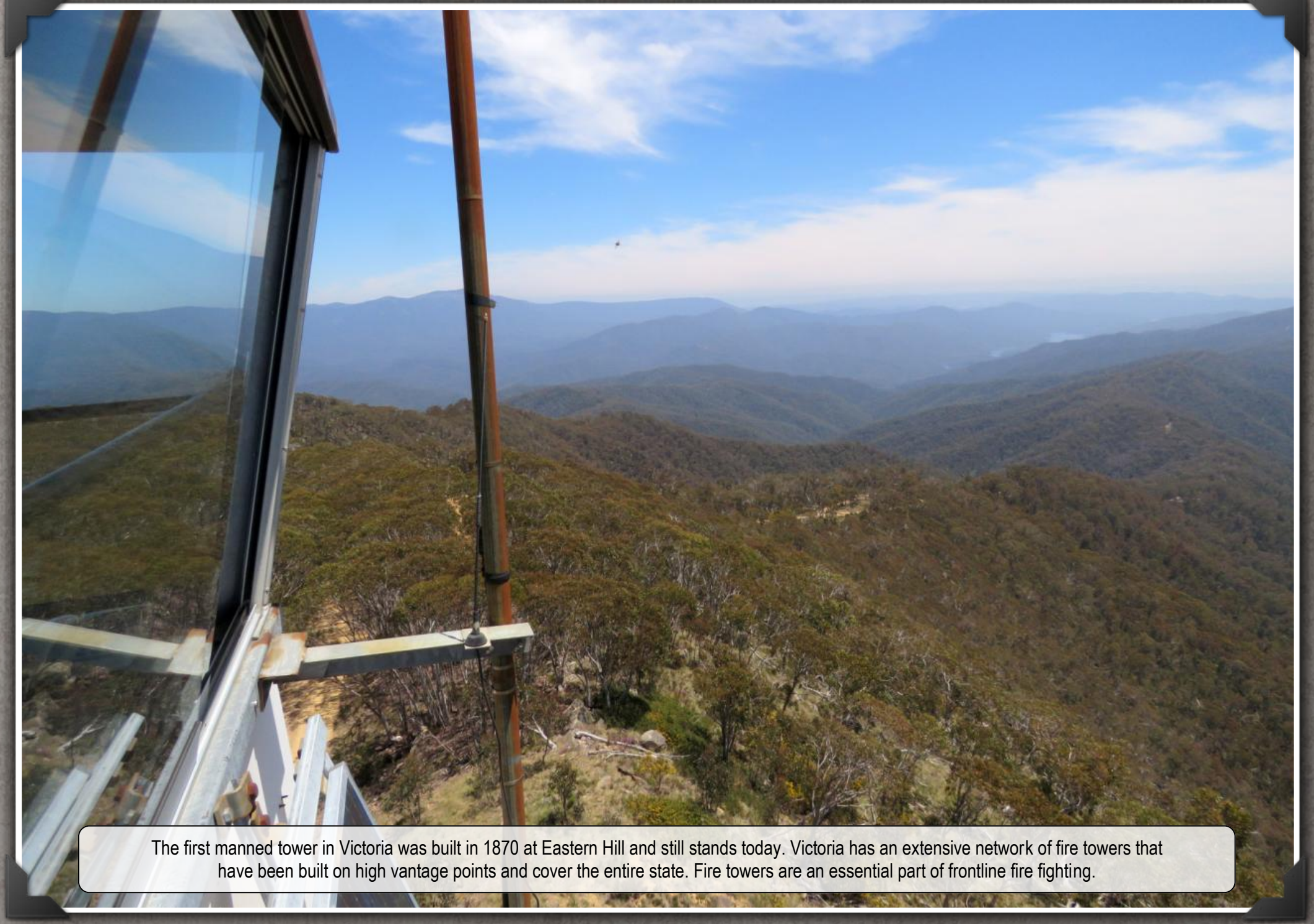
Fire spotting is the process of looking for the tell-tale wisps of smoke that could be caused by a smouldering tree hit by lightning or that has caught alight from an unattended camp fire.

Fire Tower View



Fire towers are manned by spotters during the hotter months of the year, depending on the fire danger index for the day. If a fire is spotted, it is hoped that fire crews can be dispatched to it, before the small fire grows into a bushfire. Fire spotting is carried out by the manned tower network and from helicopters and aeroplanes.

Fire Tower View



The first manned tower in Victoria was built in 1870 at Eastern Hill and still stands today. Victoria has an extensive network of fire towers that have been built on high vantage points and cover the entire state. Fire towers are an essential part of frontline fire fighting.

Air Tractor AT-802 Fighting A Fire

Sikorsky S-61 Fighting A Fire

Early Morning Deployment Preparation

Mopping Up

Mopping Up

Mopping up after a fire or controlled burn lessens the chance of the fire flaring up again and becoming dangerous. Mopping up puts out smouldering embers and areas of fire.

PERSONNEL

Volunteers

Personal Safety Equipment

Emergency Camps

ARE THERE VOLUNTEER FIREFIGHTERS IN VICTORIA?

There are around 60,000 on-call volunteer firefighters and 1,000 paid firefighters in Victoria.

DO FIREFIGHTERS WEAR SPECIAL CLOTHING?

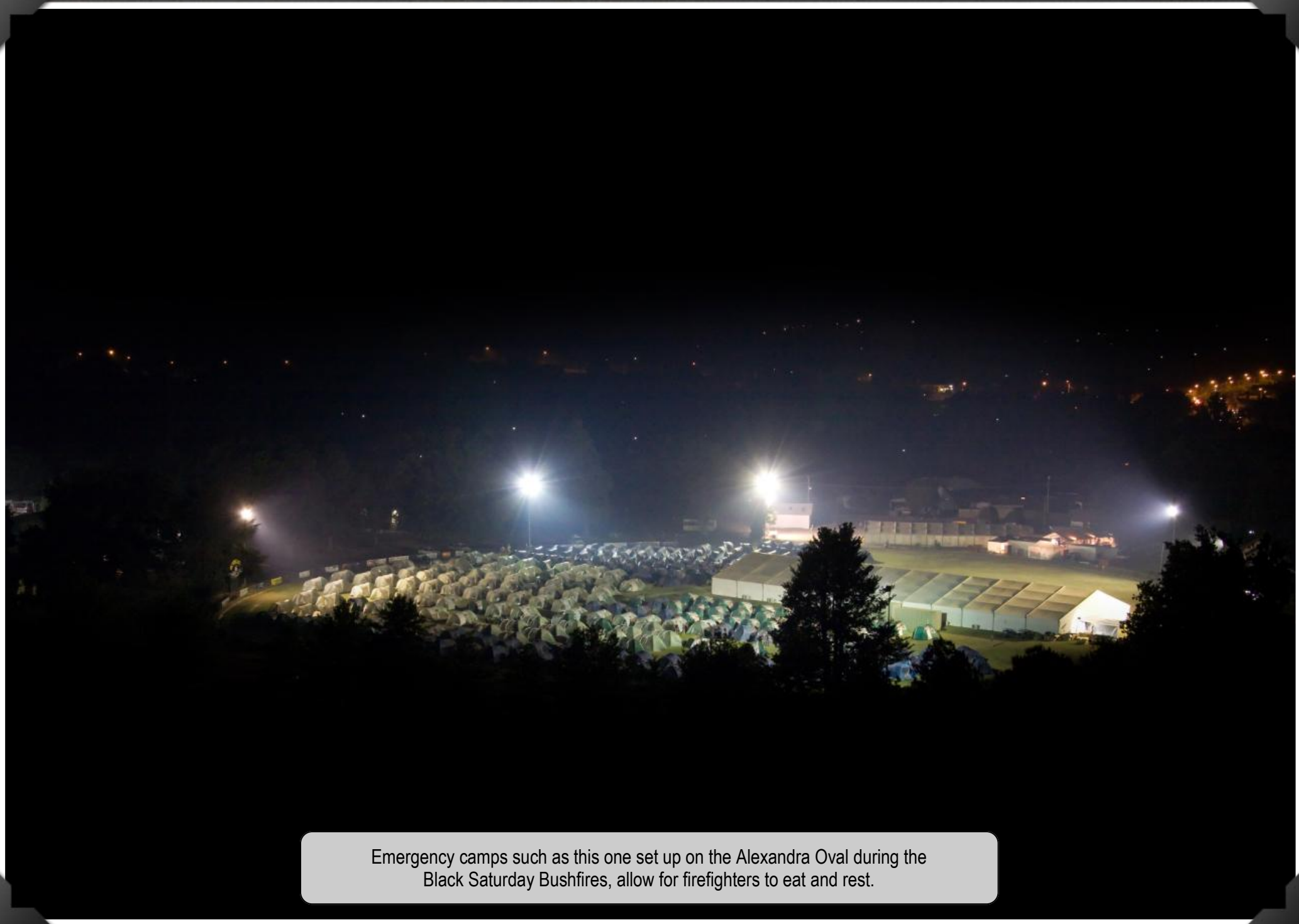
Firefighters have specially designed clothing and equipment that can resist heat and flames. While the uniforms do not stop fire, they do slow down the transfer of heat and resist flames better than normal clothing. Each firefighter has his own uniform that he looks after and cleans after a fire. Uniforms include boots, helmets, overalls, gloves and face protection.

A Firefigher's Personal Safety Equipment

WHERE DO FIREFIGHTERS SLEEP DURING LARGE FIRES?

During large fires, emergency centres are set up to feed firefighters and to give them a safe place to rest before being redeployed.

Emergency Camp



Emergency camps such as this one set up on the Alexandra Oval during the Black Saturday Bushfires, allow for firefighters to eat and rest.

GROUND/WATER SUPPORT

Ultra-Light Tanker

Heavy Tanker

Local Water Support

Alpine Support

Melbourne Water Support

Ultra-Light Tanker

LIGHT VEHICLE

Use:	Tanker
Type:	4x4 manual transmission
Engine:	Diesel
Weight	4.9 tonnes (operational)
Capacity	550 litres at 650 kPa
Rate:	200 litres per minute

The Ultra-Light Tanker carries 550 litres of water and has a small diesel-engine pump, which pumps water onto burning materials. It is used at grass fires and can gain access to steep bush and off-road areas where a larger vehicle is not able to travel safely.

Heavy Tanker

HEAVY VEHICLE

Use:	Tanker
Type:	4x4 manual transmission
Engine:	Diesel
Weight	12.5 tonnes (operational)
Capacity	3000 litres at 750 kPa (main)
	1000 litres at 750 kPa (diesel pump)
Rate:	1000 litres per minute

The Heavy Tanker can carry over 3000 litres of water in its main tank and 1000 litres of water in its smaller tank. It can pump water using the main engine or its smaller diesel-engine and is used at bushfires, grass fires, and fires in towns and cities, where it can draw water from fire hydrants.

Local Water Support

Stabicraft Marine Fire Rescue

Use:	Fire fighting, water rescue and support
Type:	Stabicraft speed boat
Engine:	Twin BF255 four stroke engines
Speed:	75 km/h (max)
Capacity:	6 adults
Fuel:	300 L
Rate:	600 litres per minute

The Stabicraft Marine Fire Rescue boat can pump water directly from where it is floating. It is mainly used to fight fires on boats, but can also rescue people from burning boats or transport people to land fires. The pictured boat has been moored at Lake Eildon since November 2009.

Alpine Support

BOMBARDIER ALPINE FIRE UNIT

Use:	Fire fighting in alpine areas
Type:	Alpine First Attack Vehicle
Engine:	Turbocharged 4.5 L
Speed:	25 km/h (max)
Capacity:	5 adults
Fuel:	Unknown

The Bombardier was introduced at Mt Buller from Canada in mid 1995 and serves primarily as a large water pump. It is slow moving, has continuous tracks so it can move around in snow, carries no water and is only used for around six weeks of winter each year. The Bombardier is supplemented by a newer Landcruiser based fire fighting unit, which is faster, easier to navigate in all seasons, and carries 300 litres of water.

Melbourne Water Support

PROMETHEUS MSV 1244 FIRE RESCUE

Use:	Fire fighting, water rescue and support
Type:	Single hulled boat
Engine:	Single Cummins QSM11
Max HP:	705 horsepower
Speed:	63 km/h (max)
Capacity:	12 adults (including a crew of four)
Fuel:	1,181 L
Rate:	16,000 litres per minute

The MFB Fireboat 2 can pump water directly from where it is floating. It is mainly used to fight fires on boats and ships, but can also rescue people from burning boats and ships or even transport firefighters to fires burning in bush near the water. Fireboat 2 has advanced features such as a infrared camera system that can detect people in the water up to 800 metres away.

AIR SUPPORT

Ericson S64 E/F Air-Crane (Elvis)
Sikorsky S-61
Boeing CH-47D Chinook
Bell 214B
Bell 206L Longranger
AS 350B3 Squirrel
S-70A Blackhawk Firehawk
Air Tractor AT-802

Ericson S64 E/F Air-Crane

LARGE HELICOPTER

Use:	Firebombing
Engine:	Twin gas turbines
Range:	2080 litres per hour
Speed:	185 km/h / 100 knots
Rotors:	6
Length:	27.3 m
Width:	6.7 m
Belly Tank:	7000 litres *(E Model)*, 9000 litres *(F Model)*

The Erickson S64 can fill its lifting bucket directly from large areas of water and drop the water onto grass and bushfires. It was first used in Australia for the 1997 bushfire season. The first one used in Australia was nicknamed *Eric.* The second was nicknamed *Elvis,* the third *Georgia Peach* and the fourth the *Incredible Hulk*. On 29 February 2019 an S64 (Christine) crashed into a dam near the Thomson Reserve. All three crew survived.

Sikorsky S-61

LARGE HELICOPTER

Use:	Firebombing
Engine:	Twin gas turbine
Range:	605 litres per hour
Speed:	225 km/h / 120 knots
Rotors:	5
Length:	17.9 m
Width:	4.4 m
Belly Tank:	3200 litres

The Sikorsky S-61 is operated in Australia by Coulson Aviation can fill its lifting bucket directly from large areas of water and drop the water onto grass and bushfires. It is one of just 119 Sikorsky helicopters ever built and is similar to the SH-3 Sea King helicopter used by the American military and Coast Guard.

Boeing CH-47D Chinook

LARGE HELICOPTER

Use:	Firebombing
Engine:	Two turboshaft turbine engines
Range:	740 km
Speed:	315 km/h / 170 knots
Rotors:	6
Length:	16 m (fuselage)
Width:	3.7 m
Belly Tank:	Unknown

The Chinook is a US military aircraft with a modified civilian variant (Boeing-Vertol Model 234) used by Coulson for water bombing. It have been operated by Coulson Aviation since 2019. N42CU was built in 1992 and arrived at Melbourne Ports on 5 January 2022. The first Chinook (N40CU) arrived in November 2021 before being sent to NSW. They can operate for just over two hours on a tank of fuel and have a retractable tank snorkel.

Bell 214B

LARGE HELICOPTER

Use:	Firebombing
Engine:	Single gas turbine
Range:	600 litres per hour
Speed:	259 kmh / 150 knots
Rotors:	2
Length:	18.5 m
Width:	2.85 m
Belly Tank:	2700 litres, Bucket: 2900 litres

The Bell 214B can fill its belly tank directly from small, medium or large areas of water and drop the water onto grass and bushfires. It is much cheaper to operate than the larger fire fighting helicopters, more flexible and able to get to fires more quickly.

Bell 206L Longranger

MEDIUM HELICOPTER

Use:	Air reconnaissance, FLIR aerial ignition
Engine:	Single gas turbine
Range:	170 litres per hour
Speed:	220 km/h / 105 knots
Length:	13 m
Width:	2.34 m
Belly Tank:	None

The Bell 206L Longranger is used to gather information, to start controlled burns and to drop water onto fires from a water bladder. It is the same helicopter used by Australian adventurer Dick Smith for his successful attempt to fly a helicopter around the world in just 260 flight hours.

AS 350B3 Squirrel

MEDIUM HELICOPTER

Use:	Firebombing, FLIR, personnel transport, air reconnaissance
Engine:	Single gas turbine
Range:	662 km
Speed:	224 km/h / 120 knots
Length:	10.93 m
Height:	2.2 m at skids
Belly Tank:	Bucket: 900 litres

The AS 350 Squirrel is a single engine helicopter capable of transporting five people. This particular one (VH-YXX) has been fitted with a water bladder which can be filled directly from bodies of water including rivers and dams (right). It can drop its payload directly onto grass and bushfires, including at close range during fire mopping up. It is much cheaper to operate than the larger fire fighting helicopters, and is more flexible.

S-70A Blackhawk Firehawk

MEDIUM HELICOPTER

Use:	Firebombing, FLIR, personnel transport, air reconnaissance
Engine:	Twin gas turbine
Range:	463 km (with 20 minutes reserve)
Speed:	224 km/h / 195 knots
Length:	19.76 m
Height:	5.33 m at wheels
Belly Tank:	Bucket: Large capacity

The S-70A Firehawk is a redesigned S-70, the US military version of the Blackhawk helicopter. The variant is used across the world for firefighting, rescue and medical evacuations. It is extremely useful thanks to being able to lift bulky cargo and equipment. In Australia it is being used for lifting water buckets for dropping on grass and bush fires. As of 2020 specialist aviation company Kestrel Aviation (est. 1985) owns two.

Air Tractor AT-802

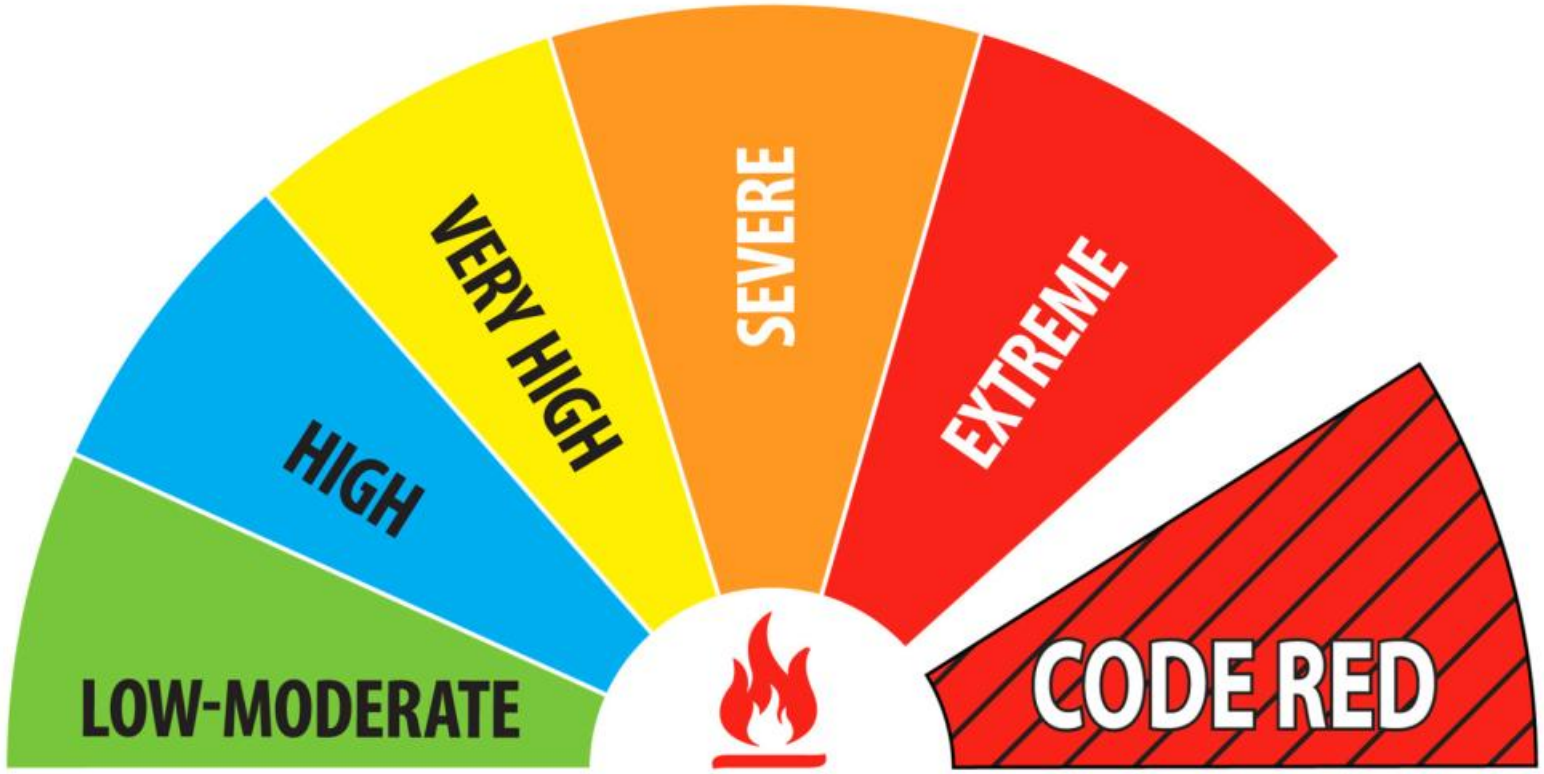
TWIN SEAT AIR TANKER

Use:	Firebombing - retardant
Engine:	Single gas turbine PT6
Range:	280 litres per hour
Speed:	280 km/h / 150 knots
Length:	10.87 m
Width:	18.06 m
Belly Tank:	3150 litres

INFO WEBSITE

The Air Tractor AT-802 is a two seat plane used to dump water or chemical fire retardant onto fires from its two tanks located under its belly. They are the world's most widely used Single Engine Air Tanker (SEAT) and are used throughout Australia.

WHAT DOES A FIRE DANGER RATING CHART TELL YOU?



FIRE DANGER RATING

A *Fire Danger Rating* chart tells us what danger a fire could pose on a certain day

	WHAT DOES IT MEAN?	WHAT SHOULD I DO?
CODE RED	These are the worst conditions for a bush or grass fire. Homes are not designed or constructed to withstand fires in these conditions. The safest place to be is away from high risk bushfire areas.	Leaving high risk bushfire areas the night before or early in the day is your safest option – do not wait and see. Avoid forested areas, thick bush or long, dry grass. Know your trigger – make a decision about: – when you will leave – where you will go – how you will get there – when you will return – what you will do if you cannot leave
EXTREME	Expect extremely hot, dry and windy conditions. If a fire starts and takes hold, it will be uncontrollable, unpredictable and fast moving. Spot fires will start, move quickly and come from many directions. Homes that are situated and constructed or modified to withstand a bushfire, that are well prepared and actively defended, may provide safety. You must be physically and mentally prepared to defend in these conditions.	• Consider staying with your property only if you are prepared to the highest level. This means your home needs to be situated and constructed or modified to withstand a bushfire, you are well prepared and you can actively defend your home if a fire starts. • If you are not prepared to the highest level, leaving high risk bushfire areas early in the day is your safest option. • Be aware of local conditions and seek information by listening to ABC Local Radio, commercial radio stations or Sky News TV, go to **cfa.vic.gov.au** or call the Victorian Bushfire Information Line on **1800 240 667**
SEVERE	Expect hot, dry and possibly windy conditions. If a fire starts and takes hold, it may be uncontrollable. Well prepared homes that are actively defended can provide safety. You must be physically and mentally prepared to defend in these conditions.	• Well prepared homes that are actively defended can provide safety – check your bushfire survival plan. • If you are not prepared, leaving bushfire prone areas early in the day is your safest option. • Be aware of local conditions and seek information by listening to ABC Local Radio, commercial radio stations or Sky News TV, go to **cfa.vic.gov.au** or call the Victorian Bushfire Information Line on **1800 240 667**
VERY HIGH **HIGH** **LOW–MODERATE**	If a fire starts, it can most likely be controlled in these conditions and homes can provide safety. Be aware of how fires can start and minimise the risk. Controlled burning off may occur in these conditions if it is safe – check to see if permits apply.	• Check your bushfire survival plan • Monitor conditions • Action may be needed • Leave if necessary

CFA PREPARE. ACT. SURVIVE. FireReady Victoria

WHAT IS
BLACK SATURDAY?

Black Saturday is the day a series of bushfires across Victoria caused great loss of life and property.
Black Saturday was 7 February 2009.

On this day 190 fires were recorded across Victoria, temperatures soared into the mid forties, winds gusted to over 100 km/h and there were 173 deaths recorded state-wide.

But there have been other serious bushfires in Victoria.

For instance, the most land burnt during one fire season in Victoria was in 1951. During this fire season almost one quarter of the State of Victoria was burnt.

On the next two pages we compare some of the more serious fire seasons.

VICTORIAN BUSHFIRE SEASONS COMPARED

Click each box for more on that fire

5
4
3
2
1

BLACK THURSDAY
47°
6 February

5 Million Hectares
41 Homes
12 lives lost

Fires covered a quarter of Victoria (approximately 5 million hectares).

Areas affected included Portland, Plenty Ranges, Westernport, the Wimmera and Dandenong districts. One million sheep and thousands of cattle were lost.

Areas burnt included: Mt Gambier to Portland, Wimmera, Seymour, the Plenty Ranges, Gippsland, Westernport, Geelong, Heidelberg, Diamond Creek, Dandenong Ranges

Victoria is roughly 20 Million Hectares (48 million acres) in size. During this fire season roughly a quarter of the State was burnt.

1851

GIPPSLAND FIRES (45°)
26 January - 10 March
60 lives lost

Gippsland, Yarra Valley, Black Range, Dandenong Ranges, Kinglake, Warburton

The Hermitage at Narbethong was only saved by a strong defence, but 12 other guesthouses were lost.

1926

BLACK FRIDAY (45.6°)
13 January
71 lives lost
1.5-2.0 Million hectares
650 Buildings burnt

Included Narbethong, Noojee, Woods Point, Omeo, Warrandyte and Yarra Glen. Other areas affected include Warburton, Erica, Rubicon, Dromana, Mansfield, the Otway Ranges and the Grampian Ranges.

1939

SUMMER LONG FIRES Dec-Feb
51 lives lost
1 Million hectares 650 Buildings burnt

Included Wangaratta (10 deaths on 22 December). The small township of Derrinallum was destroyed in January. Other fires included: the outskirts of Geelong, Hamilton, Skipton, Birregurra, Daylesford, Woodend and Gisborne.

1943-1944

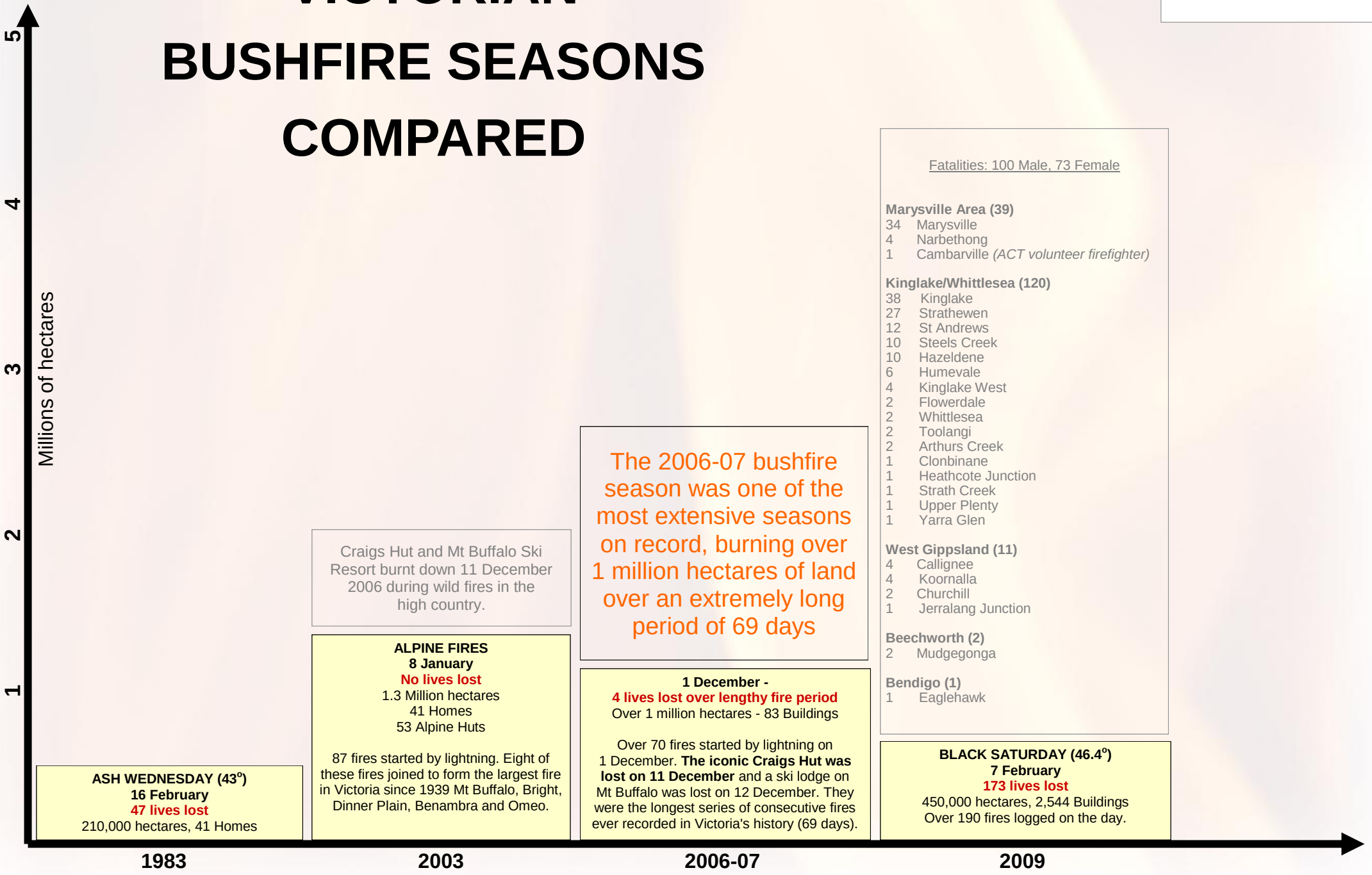
Worst affected areas included Lara, Daylesford, Yea, Darraweit, Dulgana, Korongvale and Kangaroo Flat.

CENTRAL AND SOUTHERN VIC
(Inc Lara) - 43°
23 lives lost **8 January**
250,000 hectares, 230 Homes

1969

VICTORIAN BUSHFIRE SEASONS COMPARED

Click each box for more on that fire



ASH WEDNESDAY (43°)
16 February
47 lives lost
210,000 hectares, 41 Homes

Craigs Hut and Mt Buffalo Ski Resort burnt down 11 December 2006 during wild fires in the high country.

ALPINE FIRES
8 January
No lives lost
1.3 Million hectares
41 Homes
53 Alpine Huts

87 fires started by lightning. Eight of these fires joined to form the largest fire in Victoria since 1939 Mt Buffalo, Bright, Dinner Plain, Benambra and Omeo.

The 2006-07 bushfire season was one of the most extensive seasons on record, burning over 1 million hectares of land over an extremely long period of 69 days

1 December -
4 lives lost over lengthy fire period
Over 1 million hectares - 83 Buildings

Over 70 fires started by lightning on 1 December. **The iconic Craigs Hut was lost on 11 December** and a ski lodge on Mt Buffalo was lost on 12 December. They were the longest series of consecutive fires ever recorded in Victoria's history (69 days).

Fatalities: 100 Male, 73 Female

Marysville Area (39)
34 Marysville
4 Narbethong
1 Cambarville *(ACT volunteer firefighter)*

Kinglake/Whittlesea (120)
38 Kinglake
27 Strathewen
12 St Andrews
10 Steels Creek
10 Hazeldene
6 Humevale
4 Kinglake West
2 Flowerdale
2 Whittlesea
2 Toolangi
2 Arthurs Creek
1 Clonbinane
1 Heathcote Junction
1 Strath Creek
1 Upper Plenty
1 Yarra Glen

West Gippsland (11)
4 Callignee
4 Koornalla
2 Churchill
1 Jerralang Junction

Beechworth (2)
2 Mudgegonga

Bendigo (1)
1 Eaglehawk

BLACK SATURDAY (46.4°)
7 February
173 lives lost
450,000 hectares, 2,544 Buildings
Over 190 fires logged on the day.

Glossary

carbon dioxide is a colourless gas that is formed when things are burned and when we breathe.

carbon monoxide is a poisionous colourless gas that is formed when materials containing carbon do not burn properly due to a lack of oxygen.

deadly is causing or able to cause death.

fuel is a material such as wood that is burnt to produce heat or power.

gas is a substance (such as oxygen) that is like air and has no firm shape.

inefficient is wasting materials and time to complete a task.

odourless is having no smell.

oxygen is the air that we breathe.

resist is to fight against something.

protection is something that keeps someone or something from being hurt.

smoke is a cloud of black, grey or white gases and dust that occur when materials are burned.

volunteer is a person that does something willingly, without any payment.

Parent / Teacher Resource

This book can provide information to help parents and teachers to educate children about fighting fires. It is primarily designed so that a teacher with little knowledge of the subject, can present each page as a slideshow on a large classroom screen.

It covers information on the following topics:

- About Fire
- What Fire Produces
- Controlled / Uncontrolled Fire
- Fire Related Gases
- Early Fire Fighting
- Modern Fire Fighting
- Personnal / Equipment
- Ground/Water Support
- Air Support
- Fire Danger Chart
- Black Saturday

Photographs throughout the texts, give the reader a visual representation of various aspects involved with fire fighting.

This book can also be used to teach children the following Text Features:

- Title
- Table of Contents
- Hyperlinks ^
- Headings
- Photographs
- Captions
- Labels
- Glossary

^ The Table of Contents contains Hyperlinks. If you press on one of the options, it will take you to the appropriate page.

^ There are also blue hyperlinked words throughout the text. If you press on these, they will take you to the Glossary at the back of the book. Once you have read the definition, you can press on the same blue word to take you back to the same page where you were.

Parent / Teacher Resource Links

YouTube
Video promoting volunteer fire fighters

Wiki
CFA website

Wiki
MFB website

Wiki
Fire

Wiki
History of firefighting

Wiki
Gas

Wiki
Black Saturday bushfires

Fighting Bushfires

Free Educational Resource

By ©Allan Layton and David & Debbie Hibbert

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