

## Lineage on the development of the *Fires in Australia's forests 2016–21 (2024)* dataset for the 2024 update of [Indicator 3.1b](#) for [Australia's State of the Forests Report](#).

*Fires in Australia's Forests 2016–21 (2024)* is a continental spatial dataset of the extent and frequency of **planned** and **unplanned** fires in forest in the five financial years between July 2016 and June 2021, assembled for the 2024 update of [Indicator 3.1b](#) for *Australia's State of the Forests Report*. It was developed from multiple fire area datasets contributed by state and territory government agencies, after consultation with Australia's Forest Fire Management Group. The fire dataset is then combined with forest cover information sourced from the [Forests of Australia \(2023\)](#) dataset, and forest tenure information sourced from the [Tenure of Australia's Forests \(2023\)](#) dataset.

*Fires in Australia's forests 2016–21 (2024)* dataset was developed from the following state and territory (jurisdictional) fire datasets:

- Fire scars for all land cover types detected by the MODIS satellite and mapped by [Northern Australia Fire Information](#) (NAFI). This dataset is available from the NAFI website and was used for the Northern Territory jurisdiction.
- Fire scars for all land cover types detected by the Landsat satellite and Sentinel-2 satellites and mapped by the Queensland Statewide Landcover and Trees Study (SLATS) team.
- Fire scars for all land cover types mapped or digitised from aerial photography or captured from field GPS mapping and provided by the following agencies or downloaded from respective jurisdiction data portals:
  - ACT Parks and Conservation Service
  - New South Wales Rural Fires Service
  - [South Australia Government Data Directory](#)
  - Queensland Parks and Wildlife Service
  - Tasmania Department of Natural Resources and Environment
  - [Victorian Government Data Portal](#)
  - [Western Australian Government Data Portal](#)

Relevant jurisdiction agencies, as detailed below, provided advice on how to use the data, in terms of interpreting the attributes and assigning planned or unplanned to fire records. The method to derive a fire dataset that identifies the type of fire (**planned** or **unplanned**) and the financial year in which the fire occurred for the reporting period **2016–17** to **2020–21** for each jurisdiction is summarised below:

### Northern Territory

1. Downloaded raster data from NAFI website (<https://www.firenorth.org.au/nafi3/>)
2. Separated data by financial year which resulted in five rasters of fire scars, one for each of the financial years in the reporting period 2016–17 to 2020–21.
3. Attributed each raster of fire scars with the date of fire (day, month and year) of the fire in the original dataset.
4. Allocated the fires in each raster to planned or unplanned fire type based on advice provided by Northern Territory Department of Environment and Natural Resources: **planned** fires occur between January and July; **unplanned** fires occur between August and December.
5. Where input data indicated that a cell (pixel) was burnt on multiple occasions in any one financial year, only the first fire and its fire type (**planned** or **unplanned**) was considered, and all subsequent fires occurring on that cell during that financial year were disregarded as they were considered potential data errors. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in the Northern Territory.

6. Combined the individual rasters to create an interim fire dataset for the reporting period **2016–17 to 2020–21** that included **year of fire by type of fire**.
7. Reprojected the interim fire dataset to standard NFI GDA 1994 Albers equal-area projection and resampled to 100m cell size.
8. Masked or clipped the interim fire dataset to the standard National Forest Inventory (NFI) Northern Territory boundary (also known as **NT Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
9. Combined the resulting Northern Territory fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
10. Added the following attributes to the new Northern Territory forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt ("YES") or not ("NO") between 2016–17 and 2020–21).

### Queensland

The Queensland fire dataset was derived from a combination of the vector dataset of fire scars mapped by Queensland Parks and Wildlife Service (QPWS) and the raster dataset of fire scars mapped by the Queensland SLATS team from satellite imagery (available through [Queensland Government Open Data Portal](#)). Both input datasets identified fire scars by date (month and year).

1. Converted the QPWS vector feature layers (by month, by financial year) to monthly rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS.
2. Created monthly and by year rasters from the SLATS raster dataset.
3. Combined corresponding monthly and yearly rasters from steps **1** and **2** above to create monthly rasters for financial years: 2016–17, 2017–18, 2018–19, 2019–20 and 2020–21.
4. Allocated the type of fire in each raster to **planned** or **unplanned** based on advice provided by QPWS, where a fire is **planned** if it occurs between January and July, and **unplanned** if it occurs between August and December. Where input data indicated that a cell (pixel) was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires that occurred on that cell during that financial year were disregarded. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in Queensland.
5. Combined the five individual financial year rasters to create an interim fire dataset that includes the attributes **year of fire by type of fire**.
6. Reprojected the interim fire dataset to standard NFI GDA 1994 Albers equal-area projection and resampled to 100 m cell size.
7. Masked or clipped the interim fire dataset to the standard NFI Queensland boundary (also known as **Qld Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
8. Combined the resulting Queensland fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
9. Added the following attributes to the new Queensland forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)

- c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
- d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
- e) FOREST\_BURNT (identifies where a forest area was burnt (“YES”) or not (“NO”) between 2016–17 and 2020–21).

### **New South Wales**

1. Sourced fire dataset from the NSW Rural Fire Service. The dataset was derived from hand digitizing of fire scars from aerial photography and GPS coordinates. The dataset contained **planned** fires and **unplanned** fires (wildfires).
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.
3. Separated data by financial year, which resulted in ten vector datasets of fire, five for **planned** fire for each financial year and five for **unplanned** fire for each financial year (financial years between 2016–17 and 2020–21, inclusive).
4. Converted the vector datasets to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
5. Combined the ten individual rasters (fire type by year) into an interim state-wide fire dataset
  - o Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in New South Wales.
6. Masked or clipped the interim fire dataset to the standard NFI New South Wales boundary (also known as **NSW Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of -99.
7. Combined the resulting NSW fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
8. Added the following attributes to the new NSW forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt (“YES”) or not (“NO”) between 2016–17 and 2020–21).

### **Australian Capital Territory**

1. Sourced fire dataset jointly from the ACT Parks and Conservation Service the ACT Emergency Services Agency. The dataset was derived through hand digitizing of fire scars from aerial photography and GPS coordinates.
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.
3. Converted the original shapefile from multipart polygons to single part polygons and then to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
4. Separated data by financial year and **planned/unplanned** fire, which resulted in ten vector datasets of fire, five for **planned** fire for each financial year and five for **unplanned** fire, for each financial year (financial years between 2016–17 and 2020–21, inclusive). Fire type was assigned using the ignition source attribute.

5. Combined the ten individual rasters (fire type by year) into an interim territory-wide fire dataset:
  - Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in the ACT.
6. Masked or clipped the interim fire dataset to the standard NFI Australian Capital Territory boundary (also known as **ACT Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
7. Combined the resulting ACT fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
8. Added the following attributes to the new ACT forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt ("YES") or not ("NO") between 2016–17 and 2020–21).

### Victoria

1. Sourced fire dataset from the [Victorian Government Data Portal](#). The dataset was derived through hand digitizing of fire scars from aerial photography and GPS coordinates.
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.
3. Converted the original shapefile from multipart polygons to single part polygons and then to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
4. Separated data by financial year using the 'START\_DATE' attribute, which resulted in fire vector datasets of fire, one for each of the reporting financial periods (financial years between 2016–17 and 2020–21, inclusive).
5. Separated data by fire type, **planned** and **unplanned** using the FIRE\_TYPE attribute, and excluded fires that had the value of 'unburnt' for the attribute FIRE\_SVRTY.
6. Combined the ten individual rasters (fire type by year) into an interim state-wide fire dataset:
  - Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in Victoria.
7. Masked or clipped the interim fire dataset to the standard NFI Victoria boundary (also known as **VIC Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
8. Combined the resulting Victoria fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
9. Added the following attributes to the new Victorian forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)

- b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
- c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
- d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
- e) FOREST\_BURNT (identifies where a forest area was burnt (“YES”) or not (“NO”) between 2016–17 and 2020–21).

### Tasmania

1. Sourced fire datasets from the Tasmania Department of Natural Resources and Environment. The dataset was derived through hand digitizing of fire scars from aerial photography and GPS coordinates.
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.
3. Separated data by financial year and **planned/unplanned** fire, resulting in ten vector datasets of fire, five for **planned** fire for each financial year and five for **unplanned** fire for each financial year (financial years between 2016–17 and 2020–21, inclusive). Fires attributed as **unknown** type were allocated to **planned** if they occurred between April and September and to **unplanned** if they occurred between October and March.
4. Converted the ten vectors to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
5. Combined the ten individual rasters (fire type by year) into an interim state-wide fire dataset:
  - Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in Tasmania.
6. Masked or clipped the interim fire dataset to the standard NFI Tasmania boundary (also known as **TAS Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
7. Combined the resulting Tasmania fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
8. Added the following attributes to raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2020–17 and 2016–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt (“YES”) or not (“NO”) between 2016–17 and 2020–21).

### South Australia

The method to derive a fire dataset that identifies the type of fire (**planned** or **unplanned**) and the financial year in which the fire occurred for the reporting period **2016–17** to **2020–21** for South Australia is summarised as follows:

1. Sourced fire datasets from the [South Australia Government Data Directory](#). The dataset was derived through hand digitizing of fire scars from aerial photography and GPS coordinates.
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.

3. Separated data by financial year and **planned/unplanned** fire, resulting in ten vector datasets of fire, five for **planned** fire for each financial year and five for **unplanned** fire for each financial year (financial years between 2016–17 and 2020–21, inclusive).
4. Converted the vectors to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
5. Combined the ten individual rasters (fire type by year) into an interim state-wide fire dataset:
  - Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in South Australia.
6. Masked or clipped the interim fire dataset to the standard NFI South Australia boundary (also known as **SA Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
7. Combined the resulting South Australia fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
8. Added the following attributes to raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt ("YES") or not ("NO") between 2016–17 and 2020–21).

### **Western Australia**

The method to derive a fire dataset that identifies the type of fire (**planned** or **unplanned**) and the financial year in which the fire occurred for the reporting period **2016–17** to **2020–21** for Western Australia is summarised as follows:

1. Sourced fire datasets from the [Western Australian Government Data Portal](#). The dataset was derived through hand digitizing of fire scars from aerial photography and GPS coordinates.
2. Reprojected the fire vector dataset to standard NFI GDA 1994 Albers equal-area projection.
3. Separated data by financial year and **planned/unplanned** fire, resulting in ten vector datasets of fire, five for **planned** fire for each financial year and five for **unplanned** fire for each financial year (financial years between 2016–17 and 2020–21, inclusive):
  - Fires of **unknown** burn type were allocated to **planned** or **unplanned** based on the month of occurrence and location of the fire (north or south of Tropic of Capricorn). Fires occurring between October and March and located south of Tropic of Capricorn were allocated to **unplanned** and those occurring between April and September were allocated to **planned**. Fires occurring between August and December and located north of Tropic of Capricorn were allocated to **unplanned** and those occurring between January and July were allocated to **planned**.
4. Converted the vector datasets to rasters using the polygon to raster tool with the COMBINED\_AREA option in ArcGIS and resampled to 100m cell size.
5. Combined the ten individual rasters (fire type by year) into an interim state-wide fire dataset:
  - Where input data indicated that a forest cell or pixel was burnt on multiple occasions in any one financial year, only the first fire and fire type (**planned** or **unplanned**) was considered and all subsequent fires occurring during that financial

year were not considered. For this reason, the derived fire dataset may underestimate the cumulative area of forest burnt in Western Australia.

6. Masked or clipped the interim fire dataset to the standard NFI Western Australia boundary (also known as **WA Snapgrid**) and allocated the **NODATA** areas within the mask boundary a value of **-99**.
7. Combined the resulting Western Australian fire raster with the *Forest of Australia (2023)* and *Tenure of Australia's Forests (2023)* datasets.
8. Added the following attributes to the new Western Australian forest fire raster and calculated their values:
  - a) ALL\_FIRE\_BY\_TYPE (summation of individual financial year fires between 2016–17 and 2020–21)
  - b) X\_BURNT\_P (number of times an area was burnt by **planned** fire between 2016–17 and 2020–21)
  - c) X\_BURNT\_U (number of times an area was burnt by **unplanned** fire between 2016–17 and 2020–21)
  - d) TOTAL\_X\_BURNT (number of times an area was burnt by **planned** or **unplanned** fires between 2016–17 and 2020–21)
  - e) FOREST\_BURNT (identifies where a forest area was burnt (“YES”) or not (“NO”) between 2016–17 and 2020–21).

### Australia dataset

The final forest fire rasters for each state and territory were combined into a national coverage titled *Fires in Australia's forests 2016–2021 (2024)* using the lookup tool in ArcGIS to give the final attributes (Table 1).

**Table 1: Attributes for the raster FIRE\_FOR1621**

Field	Field type	Description
VALUE	Numeric	Unique identifier for each unique combination of attribute table field values.
COUNT	Numeric	Number of cells that occur for a particular VALUE. For this dataset the cell size is 100 by 100 metres. The COUNT value is equivalent to the area in hectares.
FOR_TEN	String (Text)	NFI forest tenure class/type. This applies to both forest and non-forest land. OCL = Other Crown land, PRIV = Private forest, LEASE = Leasehold forest, NCR = Nature conservation reserve, MUF = Multiple-use public forest, ND = Unresolved tenure. <sup>1</sup>
FOR_CATEGORY	String (Text)	Forest category
Forest	Numeric	Binary field indicating whether pixel is forest or non-forest. FOREST = 1, Non-forest = 0
STATE	String (Text)	State or territory in which the cell occurs.
FIRE_1617	String (Text)	Identifies forest burnt by planned or unplanned fire in financial year 2016-17. P=planned, U=unplanned. <sup>1</sup>
FIRE_1718	String (Text)	Identifies forest burnt by planned or unplanned fire in financial year 2017-18. P=planned, U=unplanned. <sup>1</sup>
FIRE_1819	String (Text)	Identifies forest burnt by planned or unplanned fire in financial year 2018-19. P=planned, U=unplanned. <sup>1</sup>
FIRE_1920	String (Text)	Identifies forest burnt by planned or unplanned fire in financial year 2019-20. P=planned, U=unplanned. <sup>1</sup>
FIRE_2021	String (Text)	Identifies forest burnt by planned or unplanned fire in financial year 2020-21. P=planned, U=unplanned. <sup>1</sup>



ALL_FIRE	String (Text)	Concatenation of values in fields <b>FIRE_1617, FIRE_1718, FIRE_1819, FIRE_1920, FIRE_2021.</b>
FOR_BURNS	Numeric	Number of times a forest pixel was burnt between 2016 and 2021: 0=not burnt, 1= 1 burn, 2=2 burns, 3=3 burns, 4=4 burns, 5= 5 burns, -9= Non-forest (may be burnt or unburnt).
FOREST_BURN_TYPE	String (Text)	Groups forest burnt by burn type: <b>Unplanned burns only, Planned burns only, Planned and Unplanned burns, Forest not burnt.</b>

<sup>1</sup> Refer to [Australia’s forests and forestry glossary](#) (ABARES 2020) for definitions.

**Table 2: Attribute symbology and colour values for number of burns during the reporting period in the raster FIRE\_FOR1621.**

FOR_BURNS	Description	RGB values			Hexadecimal value	Colour
		R	G	B		
-9	Non-forest	240	240	240	#f0f0f0	
0	Forest not burnt	178	178	178	#b2b2b2	
1	Forest burnt one time	255	255	0	ffff00	
2	Forest burnt two times	255	170	0	ffaa00	
3	Forest burnt three times	168	112	0	a87000	
4	Forest burnt four times	168	56	0	a83800	
5	Forest burnt five times	115	0	77	#73004d	

**Table 3: Attribute symbology and colour values for type of burn during the reporting period in the raster FIRE\_FOR1621.**

For_Burn_Type	RGB values			Hexadecimal value	Colour
	R	G	B		
Non-forest	240	240	240	#f0f0f0	
Forest not burnt	178	178	178	#b2b2b2	
Planned and Unplanned burns	107	0	0	#6b0000	
Planned burns only	255	255	0	ffff00	
Unplanned burns only	242	167	46	#f2a72e	