

Fire case studies:

Meteorological conditions and extreme fire behaviour at 2021 Wooroloo fire in Western Australia

Department of Fire and Emergency Services
Rural Fire Division – Bushfire Technical Services

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The Wooroloo Fire

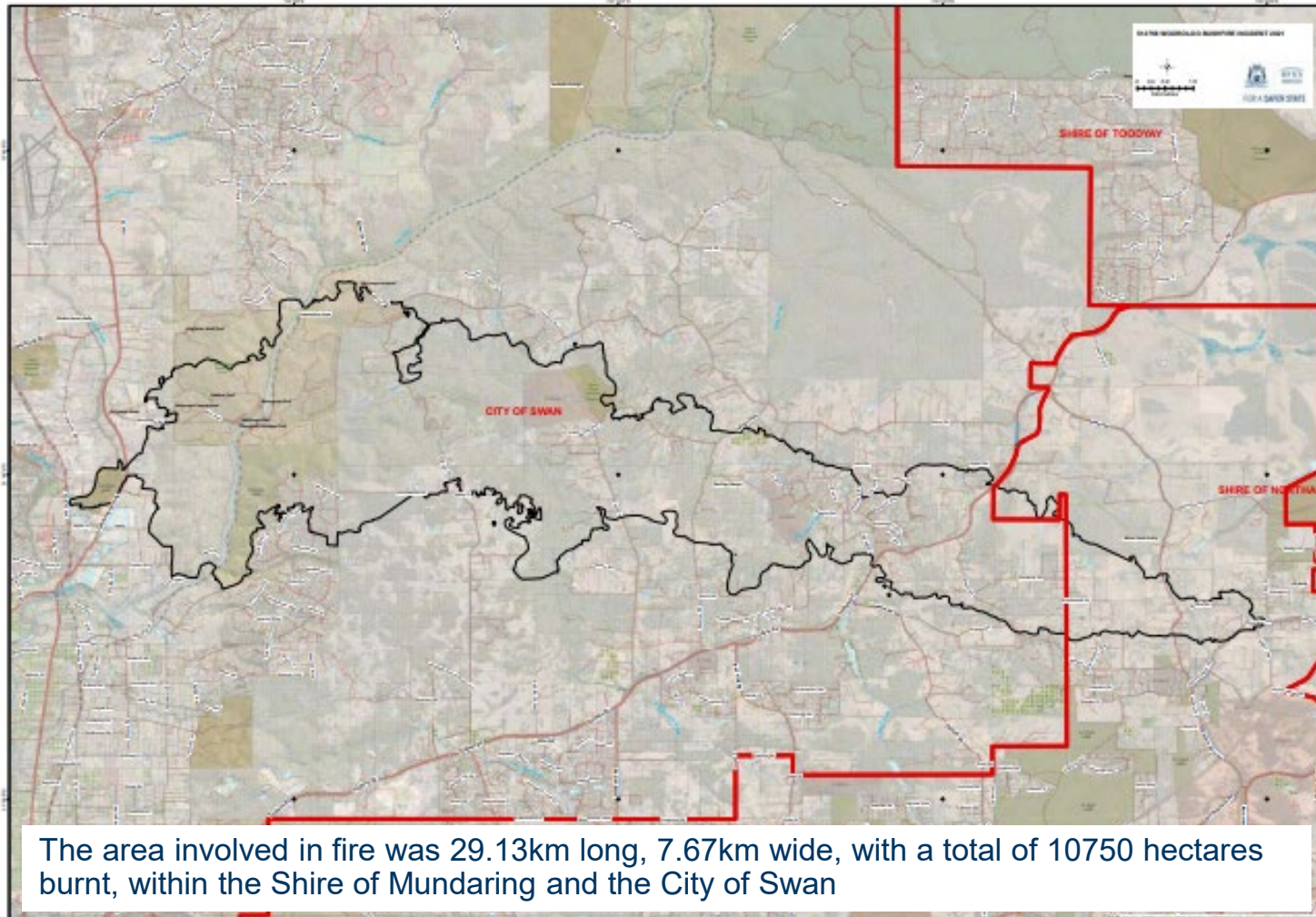
- The fire started near Werribee Road, Wooroloo on **Monday 1 February 2021**, and was first reported at **1202 pm**.
- Fire Danger on **1st February**:
 - Gingin Airport: 60 for Grass Fire Danger Index (GFDI) and 67 for Forest Fire Danger Index (FFDI) classified as a Severe Fire Danger Rating
 - Gooseberry Hill: 39 (GFDI) and 53 (FFDI) classified as a Very High Fire Danger Rating
 - Total Fire Ban and Harvest Vehicle Movement Ban was declared for the Perth Metropolitan, City of Swan and Shire of Mundaring from midnight on the 1 February.
- By **mid-afternoon** there were 500 firefighters and 95 vehicles involved in the firefighting effort, along with fixed wing and rotary water bombers.
 - Under the conditions the fire moved quickly and by **1545hrs** 230 ha was reported burnt as the fire moved in a north-westerly direction, jumping Toodyay Road 10km from the point of ignition and threatening the Walyunga National Park.
 - Firefighters were encountering erratic fire conditions travelling at 3-4km/h with spot fires up to 500 metres ahead of the fire front with the priority to protect life and then property.
- Telephone Warning System (TWS) - Emergency Alerts were issued to Gidgegannup, Brigadoon, Upper Swan and Bullsbrook at **2300hrs** as the fire intensity increased.
- **On Tuesday 2nd February 2021**, by **0100hrs** the fire had spotted 3.5km and was burning on the north-western side of the Avon River and threatening properties. Additional resources including contract heavy machinery and strike teams were requested for five days.





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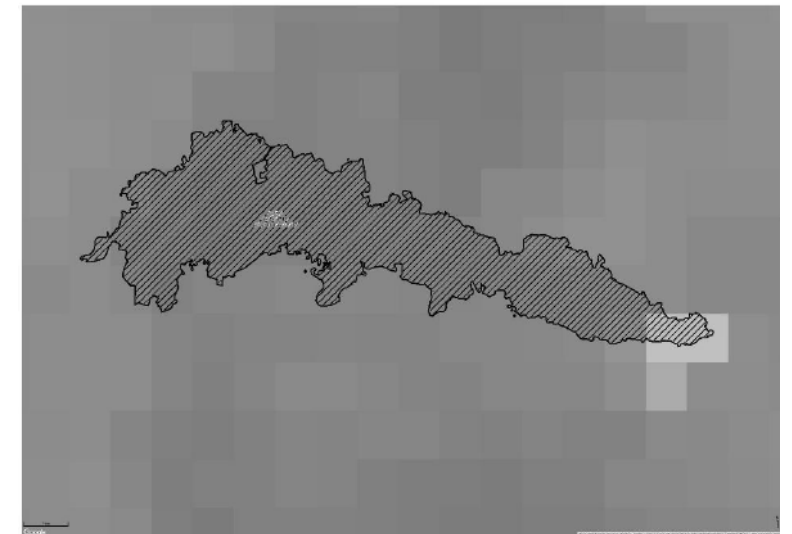
The Wooroloo Fire



The area involved in fire was 29.13km long, 7.67km wide, with a total of 10750 hectares burnt, within the Shire of Mundaring and the City of Swan



A large smoke plume and flames are visible from the highway road block. (ABC News: Andrew Chounding)



Himawari capture 12:00 on 1st February 2026 showing heat anomaly near ignition.





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Weather Conditions

12 Hour Forecast commencing 1300 hours Monday 1 February 2021												
Drought factor: 10 Curing value (%): 100 Grass Fuel Load (t/ha): 4.5												
Local Time	Temp (C)	Dewpt (C)	RH (%)	10m Wind (km/h)			1000m AGL Wind (km/h)		FDI	Mix Height (m) AMSL	cHaines	TAL
				Dir	Speed	Gust	Dir	Speed				
1300	34	7	19	ESE	25	35	E	35	25	2600	7	0
1400	35	5	16	ESE	25	35	E	35	28	2800	8	0
1500	36	3	13	ESE	25	35	E	35	31	3000	9	0
1600	36	2	12	ESE	25	35	E	35	32	3000	9	0
1700	35	1	12	ESE	25	35	E	35	31	3000	10	0
1800	34	1	12	ESE	25	30	E	40	30	2700	10	0
1900	31	1	15	ESE	20	25	E	45	18	1300	10	0
2000	29	1	16	ESE	20	25	E	45	17	300	9	0
2100	27	2	20	ESE	20	30	E	50	14	300	9	0
2200	26	2	21	ESE	20	30	E	55	13	300	8	0
2300	25	2	22	ESE	25	30	E	55	18	300	8	0
0000	24	4	27	ESE	25	35	ENE	55	16	300	8	0
0100	22	6	35	ESE	20	30	ENE	55	9	300	7	0

AGL - Above Ground Level, RH - Relative Humidity, Dir - Direction, Dewpt - Dew Point, cHaines - Continuous Haines (0-13), TAL - Thunderstorm Activity Level (0-3). Note: Mixing height is above Mean Sea Level (MSL), to get AGL height subtract incident elevation from value given.

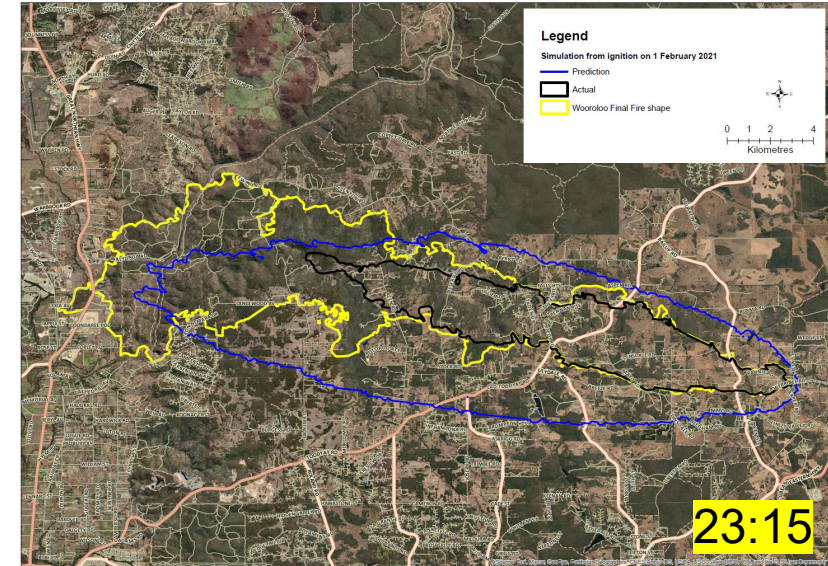
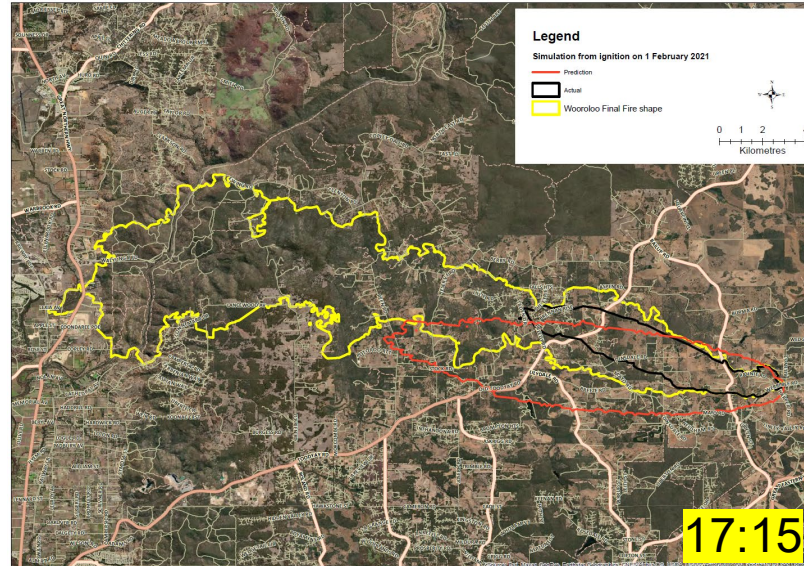
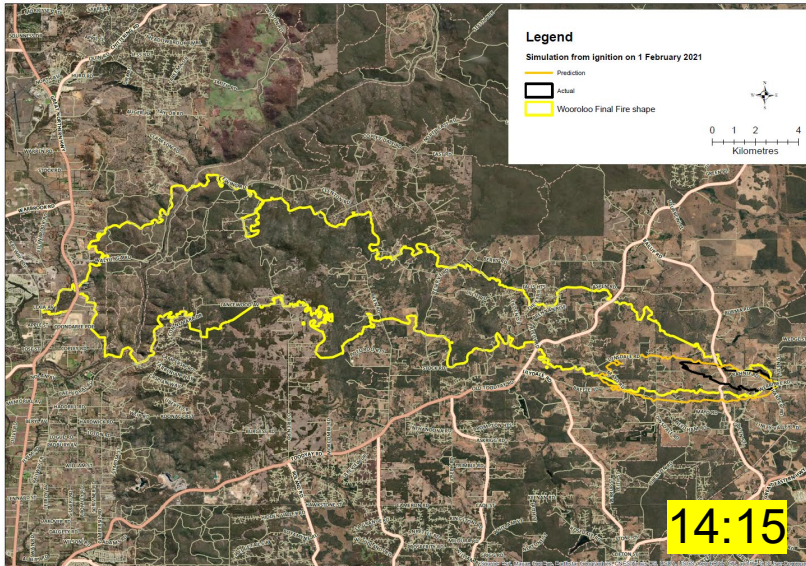
24 Hour Forecast commencing 2100 hours Monday 1 February 2021												
Drought factor: 10												
Local Time	Temp (C)	Dewpt (C)	RH (%)	10m Wind (km/h)			1000m AGL Wind (km/h)		FDI	Mix Height (m) AMSL	cHaines	TAL
				Dir	Speed	Gust	Dir	Speed				
2100	28	-2	14	ESE	15	25	E	50	28	200	9	0
2200	27	-1	16	ESE	20	30	E	55	28	300	9	0
2300	26	0	18	ESE	25	35	E	55	29	300	8	0
0000	25	0	19	ESE	25	35	ENE	55	27	200	8	0
0100	24	2	24	ESE	25	35	ENE	55	22	200	7	0
0200	23	3	27	ESE	25	35	ENE	55	19	200	7	0
0300	22	4	31	ESE	25	35	ENE	50	16	200	7	0
0400	21	5	35	E	25	35	NE	50	14	200	7	0
0500	21	6	38	E	25	35	NE	45	12	200	7	0
0600	21	6	38	E	25	30	NE	40	12	200	7	0
0700	23	6	33	E	25	35	NE	35	15	400	7	0
0800	26	6	28	E	25	35	ENE	35	20	800	7	0
0900	28	8	28	ENE	25	35	ENE	30	22	1100	7	0
1200	34	9	22	E	20	25	ENE	25	29	2400	6	0
1500	36	10	21	E	15	20	ENE	15	29	3000	8	0

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24 Hour Forecast commencing 2100 hours Monday 1 February 2021												
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Local Time	Temp (C)	Dewpt (C)	RH (%)	10m Wind (km/h)			1000m AGL Wind (km/h)		FDI	Mix Height (m) AMSL	cHaines	TAL
				Dir	Speed	Gust	Dir	Speed				
1800	34	11	25	ENE	15	20	ENE	20	23	2400	7	0
2100	26	14	48	NE	15	20	NE	25	8	200	5	0



The Wooroloo Fire



- Simulation assumes no suppression or suppression not successful,
- Assumed active edge – from Satellite Observation VIIRS at 13:02 on 1st February 2021



The Wooroloo Fire

- Rain on Saturday night **6 February 2026** and Sunday **7 February 2026** saw 15 mm fall across the fire ground over the weekend.
- The fire was declared to be extinguished on **7th February 2021**. The area involved in fire was 29.13km long, 7.67km wide, with a total of 10750 hectares burnt, within the Shire of Mundaring and the City of Swan
- Significant property loss and infrastructure damage, particularly in the first 24 hours, with initial assessment indicating 86 properties were destroyed. Subsequent analysis and assessment of the fireground has determined that there were 110 dwellings impacted, with 86 destroyed. The hardest hit area was Tilden Park, which accounted for 80% of the property losses
- The estimated insurance loss of the Wooroloo bushfire was \$93 million



Credit: Evan Collis



The Wooroloo Fire *share learnings post event*

- The 2021 Wooroloo bushfire was driven by the extreme conditions typical of a Western Australian summer : high temperatures, low humidity, and strong east/south-easterly winds, exacerbated by extreme drought.
The fire tripled in size overnight due to unprecedented low dew points (-5°C), not alleviating fire conditions overnight and preventing normal firefighting relief.
- Wooroloo fire – key finding
 - Low Level Jet below $\sim 500\text{m}$ elevation above topography
 - Wind speed 65 km/h within $\sim 100\text{ m}$ of surface
 - Driver of overnight fire spread
- The Access Modelling can also assist in determining which observation locations—such as Pearce, Maldon, Perth Airport, or Gooseberry AWS—most accurately represent the fire weather conditions.
- The analysis of fire case studies enables better-informed and more effective decision-making.





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