SMOKE AND FIRE

ANALYSING PRESCRIBED BURNING AND WILDFIRE MANAGEMENT IN SOUTH WEST WA

A project funded by the Koorabup Trust

Gondwana Link Ltd.

PART ONE

From First Smoke - The potential for rapid response in six lightning-strike wildfires.

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Acknowledgments

Thanks to the Koorabup Trust for funding this work.

Thanks to Gondwana Link Ltd for hosting the project and having us work on it.

Thanks to the steering group from Gondwana Link Ltd – Amanda Keesing and Joanna Young.

Thanks to the people interviewed.

Thanks to Terry Dunham, Val & Tim Saggers and Vince Hilder for supplying photographs.

Please cite as: Neville, S and Schultz J (2021). From First Smoke - The potential for rapid response in six lightning-strike wildfires. Gondwana Link Ltd. Albany

BACKGROUND AND PROJECT BRIEF

Project Description

This document reports on Part One of "Smoke and Fire: Analysing prescribed burning and fire management planning in South West WA", a project funded by the Koorabup Trust.

The initial project proposal to Koorabup Trust specified:

This project would review critical aspects of fire management planning in South West WA. It would be specifically aimed at providing accurate and quantified information about recent outcomes. We will collate evidence about two aspects of prescribed burning that are contentious:

- *delayed responses to fires in the conservation estate; and*
- *increased burning over the last 4 years within the SW Forest Management plan area.*

Outcomes from fire case studies will be collated and used to develop a case for increased attention to rapid-response fire suppression capability in WA.

Project Context

Wildfire has become an issue of national significance, as climate change begins to take effect and Australia suffers through its worst ever fire season in 2019-20. The main practice for attempted control of wildfire risk – prescribed or fuel-reduction burning (PB) – is being promoted more than ever as the key tool in reducing fire risk and damage to both biodiversity values as well as lives and property. At the same time there is increasing evidence that it is not effective – or even **cost** effective – as illustrated in major fires over the last summer occurring irrespective of the presence of PB. In addition to concern over effectiveness, there is increasing concern that PB in addition to wildfires is a major driver of species stress and will be leading to species extinctions through ever more frequent burning.

The adoption in WA of a very ambitious target for prescribed burning[1] in forest areas of the SW corner (200,000 ha per year out of a total of 2.5 million ha), and the recent increase in funding to achieve this, has led to an acceleration of burning over the last 3-4 years. However an assessment is required to unpack where this burning program is being carried out. A concern driving this study as that the bulk of additional burning is taking place in forest and coastal ecosystems set aside for conservation, rather than in State Forest and areas previously disturbed by mining. There is real concern that this will accelerate impacts on conservation values in those areas specifically set aside to protect those values.

[1] "The Enhanced Prescribed Burning Program's collaborative approach to bushfire mitigation has enabled DBCA's Parks and Wildlife Service to exceed its prescribed burning targets in 2016-17 and 2017-18."

https://www.dpaw.wa.gov.au/news/media-statements/minister-for-environment/item/3678-22-million-funding-boost-for-prescribed-burning

A second area of major concern emerging around Australia, and exacerbated in WA by the history of a number of fires between 2015 and 2019, is that inadequate effort is being made for early suppression of fires, even though new satellite technologies are providing very early warning of ignition. In other states specific firefighting strategies using remote-access capable fast attack teams[2] are increasingly used to attack remote fires – but not in WA.

There is anecdotal evidence that fires – especially in national parks or conservation areas – are being reported but it is many hours before any suppression activities begin. By this time fires are often large and difficult to control, and in some cases this has led to large intense fires burning in conservation areas. National Parks are then discussed primarily as areas of fuel, not as areas of often fragile biodiversity.

Both of these issues require research to help us understand where prescribed burning is being conducted, and is impacting large scale values plus fragile systems of limited distribution, and to illustrate if conservation values are being sacrificed, knowingly or unknowingly, in a quest to reduce fire risk.

This research in WA fits into an effort nationally to re-direct fire risk management away from area-targeted prescribed burning programs – which burn huge remote areas without any reduction in fire risk to built or human assets – and into more appropriate programmes with fire ecology a basis for planning. Recent research into prescribed burning in areas close to assets (the "wildland–urban interface") suggests they could provide greater hazard reduction than broad-scale prescribed burning, although at greater economic cost (Florec et. al. 2020). The costs in this research however do not factor in the environmental costs of broad-scale prescribed burning. Nor do they account for avoided costs of fighting wildfires as a result of a more efficient and better-resourced very early suppression. So it is entirely conceivable that the avoidance of broad-scale PB in the future may have equivalent cost-efficiency as well as risk reduction. This is important, as it comes as the prescribed burning window reduces with climate change (Virgilio et. al. 2020) and when alternatives may well be essential.

Part One Objective

This current project component (Part One) investigates a selection of six recent fires, and is intended to test the understanding that delayed responses led to more severe outcomes. The six fires were chosen to compare a range of early fire histories. These fires were all serious, and in two cases caused fatalities, and the purpose of this study is to assess if better early intervention may have affected outcomes.

The fires examined were all wildfires, and were all caused by lightning strike.

- Cascade-Scaddan Fire (Esperance) (2015) [81,000 ha];
- O'Sullivan (Northcliffe) Fire (2015) [80,000 ha];
- Waroona-Yarloop (Fire 68) (2016) [69,000 ha];
- Bremer Bay Fire (2018) [10,000 ha];
- Mondurup Peak (Stirling Range) Fire (2019) [6,000 ha]; and
- Mt Success (Stirling Range) Fire (2019-2020) [40,000 ha].

METHODS

Research Process

The process for investigation was as follows:

- Accessing and assessing weather records (BOM)
- Accessing satellite fire records (various sources, mainly MODIS website)
- Assessing fire reports (FESA/Coroner/Legal)
- Mapping Fire Progressive Outlines based on above
- Interviews with eye witnesses/participants
- Writing detailed fire histories (based on all above)
- Synthesising Fire Histories
- Condensing histories for presentation

Weather Records

Bureau of Meteorology weather station records were identified and downloaded from the BOM, and have been incorporated in the timelines. Records were sources from the nearest station(s) in each case. Note that only automated stations have continuous recording, and these were some distance away in most cases:

- O'Sullivan - Shannon, Windy Harbour and North Walpole (29/01/15 to 08/02/16). Limited readings for Windy Harbour.
- Cascade Scaddan – Esperance (15/11/15 to 25/11/15)
- Waroona – Dwellingup (05/01/16 to 08/01/16)
- Bremer Bay – Jacup (20/12/18 to 02/01/19). Very limited recordings from Ongerup as well.
- Mondurup Stirling Range – Albany Airport (07/12/19 to 10/12/19. Very limited recordings from Ongerup as well.
- Mt Success Stirling Range – Albany Airport (26/12/19 to 05/01/20).

Fire records were provided by BOM as .csv files and converted to .xlsx files.

Fire Reports

For three of the fires public reports are available; the two fires that caused fatalities (Cascade-Scaddan and Waroona) had very extensive reviews or inquests:

- O'Sullivan – FESA Incident Report
- Cascade Scaddan – Coroners Report and Independent Legal Report (Pacer Legal)
- Waroona (Fire 68) – Special Inquiry Report (Ferguson Report)

All four of the reports contained fire timelines, which were very detailed in the three reports into Cascade-Scaddan Fire and the Waroona Fire. Detailed mapping of fire development was included in the O'Sullivan FESA report and Volume 2 of the Waroona Fire Inquiry.

Two of the fires on DBCA land have not had reports released:

- Mondurup Stirling Range – No DBCA Report
- Mt Success Stirling Range - No DBCA Report

We were able to have two meetings with DBCA staff who were involved in these fires (up to Incident Controller level) and we are satisfied that they have provided a full account of the early events. This has been corroborated with satellite information.

Any report on the Bremer Bay fire – which was mainly on crown land under local government control but was then transferred to DFES – will only be available under FOI. A couple of different witnesses/participants were interviewed and again a consistent picture emerged and was confirmed by satellite information.

Satellite Hotspot Data

We wanted to source historical fire data for the various fires to be able to plot initial sites and fire spread over time – especially where this was not available from existing reports. A number of satellites monitor the earth's surface to fire indicators, and provide real-time notification of fires (eg Firewatch website). Accessing historical data from these requires that they are archived on the web.

Three of these satellites had archived data suitable for our purpose: the Terra (originally known as EOS AM-1) and Aqua (originally known as EOS PM-1) satellites of NASA, and the Suomi NPP (Suomi National Polar-Orbiting Partnership) spacecraft from NOAA.

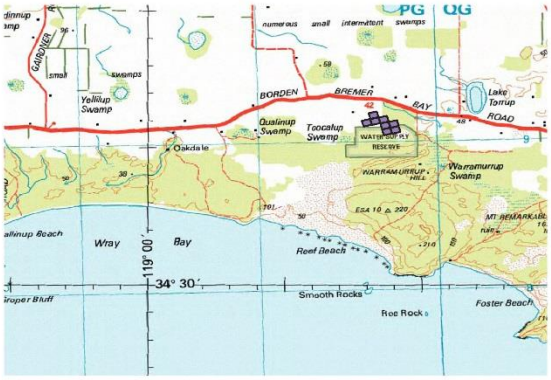
The MODIS (or Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra (originally known as EOS AM-1) and Aqua (originally known as EOS PM-1) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands – including infrared. A range of resolutions are used, but for the Thermal Anomalies product (bands 31 & 32) the resolution is 1km (1000m).

The VIIRS (or Visible Infrared Imaging Radiometer Suite) on the Suomi NPP has moderate resolution-imaging capabilities, with a pixel resolution of 375m. It is a Near Real Time (NRT) S-NPP/VIIRS 375 m active fire detection data product that uses all five 375 m VIIRS channels to detect fires and separate land, water, and cloud pixels in the image.

The range of wavelengths allows for indicators of fires to be captured, and we were able to source archived data for each of the 6 fires, from a range of these satellites. As noted the data from the MODIS on the Aqua & Terra Satellite is lower resolution than the VIIRS on the Suomi NPP. Not all fire extent may be mapped due to the time fires grew and the timing of the satellite passes. Fire archives were accessed from the NASA EarthData website.

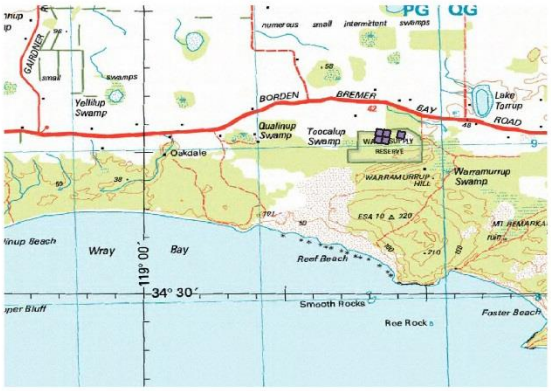
Datasets were downloaded for each fire, and aggregated by GMT, and provided as a Geopackage (.gpkg) for use in mapping fire outlines over time in QGIS. An example of the Fire hotspot extents in place over time is shown for the Bremer Bay fire in Figure 1.

Bremer Bay fire December 2018



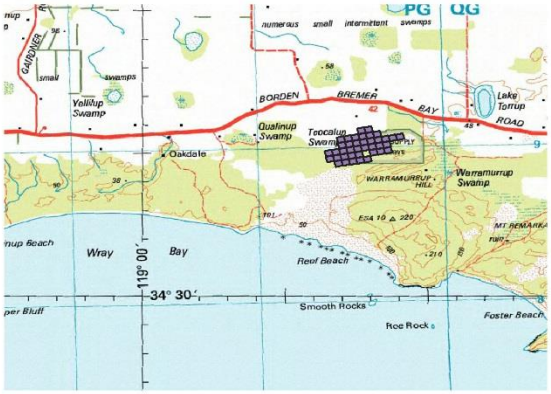
20 December 2018 02:08 PM

Temperature: 23
Wind: South-East 25 km/h
Humidity: 33



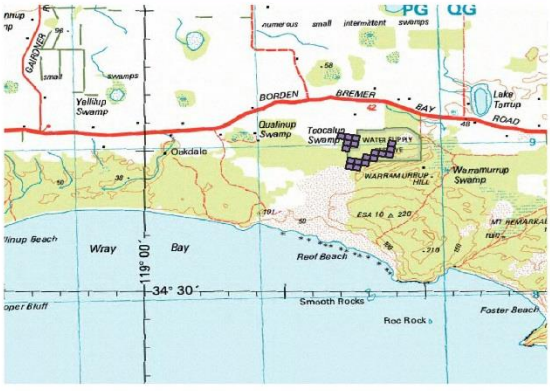
21 December 2018 01:28 AM

Temperature: 12
Wind: East 15 km/h
Humidity: 90%



21 December 2018 01:50 PM

Temperature: 28
Wind: East 25 km/h
Humidity: 30%



22 December 2018 01:09 AM

Temperature: 12
Wind: North-East 10 km/h
Humidity: 90%

0 10 20 km

1/4

Figure 1 – Example Satellite Hotspot mapping – Bremer Bay Fire.

Other source of satellite data were the Sentinel 1 & 2 datasets from the European Space Agency (ESA). These provided a much higher resolution data (approx. 16x16m pixels) but are collected on a much less frequent basis (approximately every 5 days). Comprising both visible and infrared sensors they were used to map final outlines and for progress checks in a couple of cases. The image in Figure 2 shows the detail of these images. Contrast with the Suomi NPP data in Figure 3.

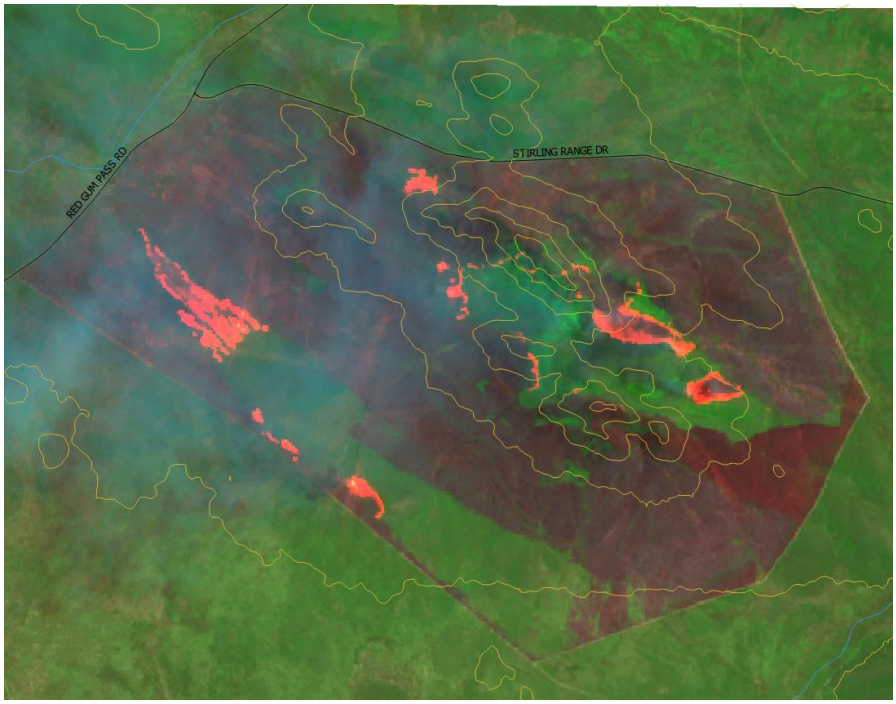


Figure 2 - Mondurup Fire early morning of December 10th (day 4) Sentinel 2 L1C. Bright red areas show active fire, dark red burnt extent.

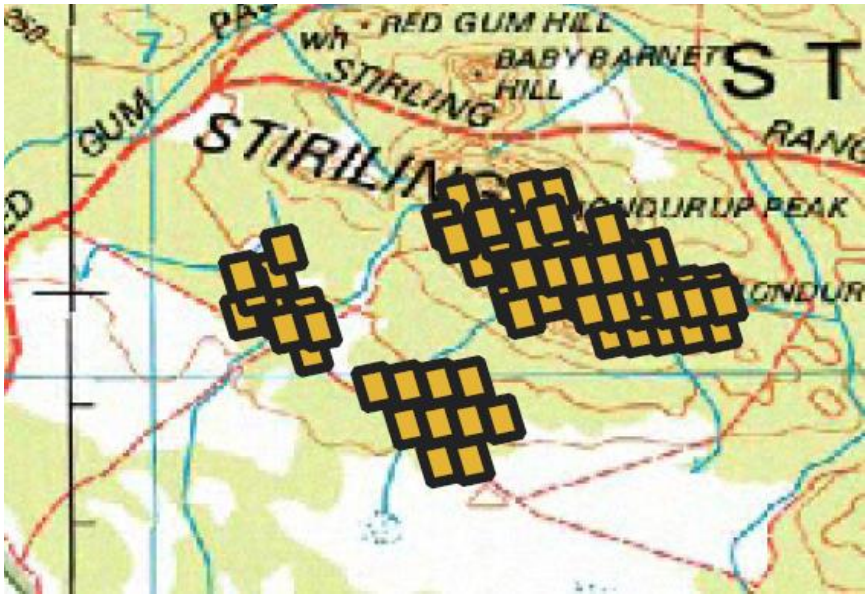


Figure 3 - Mondurup Fire late morning of December 10th (day 4) Suomi NPP. Squares show approx. fire extent.

Mapping Fire Progressive Outlines

Progressive fire outlines are used in the each timeline. If mapping was available in the reports, we adapted or used these maps as they were. So for the O'Sullivan fire we have not done any mapping, but we have checked the Hotspot mapping against the mapping provided in the FESA report and found close correspondence. We have used the FESA maps 'as is' in the timeline. The Waroona report provided a single map with multiple outlines of fire extent – we have traced these in a serious of shape is in the GIS and check them against the Hotspot mapping as well.

For each fire where we needed to actually map the increasing fire extent over time this was based on the Satellite Hotspot mapping discussed above. Most extents were mapped using only the Suomi NPP datasets, as the others were simply too coarse. Due to the low resolution data, and the timing of satellite passes, the process involved a certain amount of guesswork and interpolation. Checking was carried out using the Sentinel data where available.

The datasets used were adjusted to WST (from GMT), and the shapes drawn were progressive – each successive fire outline included the previous extents. From this the size of the fire at each stage has been calculated, and the direction of spread understood. The use of progressive maps allows for each fire to be seen in terms of its development, as shown below for the Bremer Bay Fire:

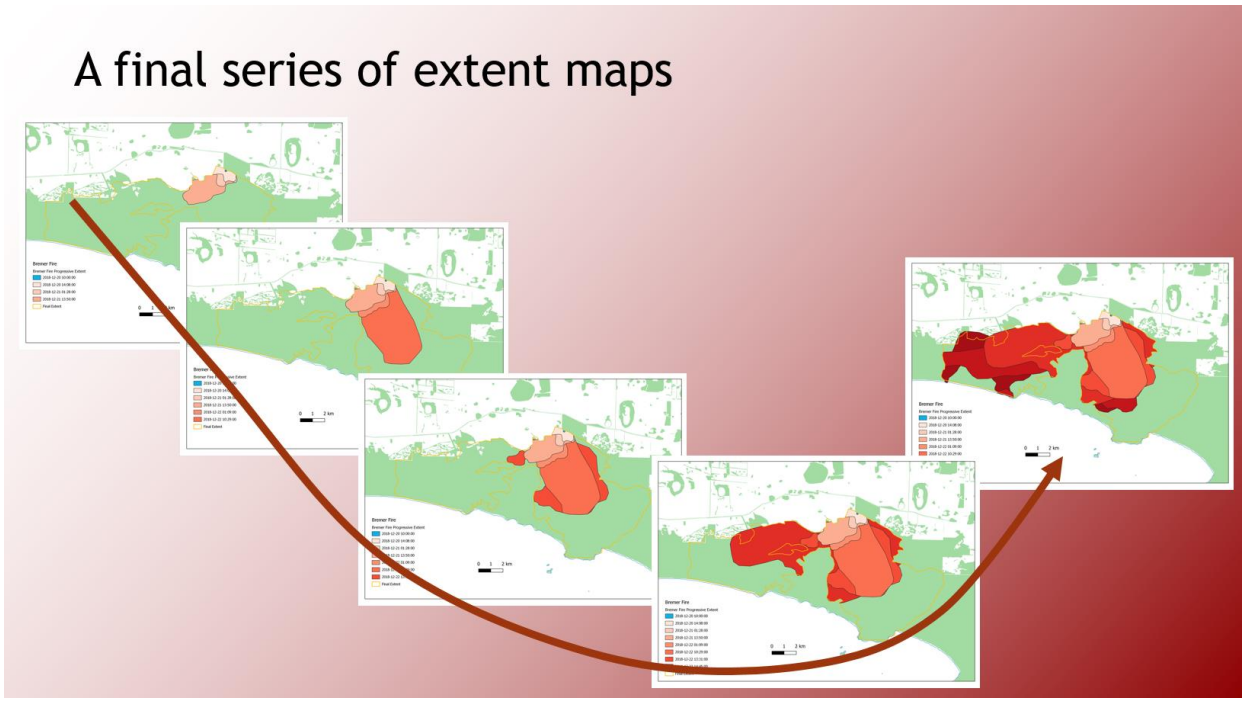


Figure 4 – Bremer Bay Fire Development

Interviews

Limited interviews were conducted to add to existing sources of information for the three fires without extensive reports:

Mondurup – Val & Tim Saggers (Farmers west of Stirling Range NP), Vince Hilder (DBCA Albany Fire Officer) and Nicky Rouse (DBCA Frankland Fire Officer); Greg Mair (DBCA South Coast Regional manager; Duty Officer for fire) and Dave Atkins (DBCA Regional Leader, Fire Management).

Mt Success – Terry Dunham (resident at Stirling Range Retreat), Bart Lebbing (Denmark Fire Study group and on site from East Denmark BFB), Greg Mair (DBCA South Coast Regional manager; Duty Officer for fire), Vince Hilder (DBCA Albany Fire Officer and Incident Coordinator) and Dave Atkins (DBCA Regional Leader, Fire Management).

Bremer Bay Fire – Anthony Thomas (Boxwood Hill BFS, fire Ground Controller); Ash Peczka (Community Emergency Services Officer, Jerramungup); Charmaine Solomon (Deputy CEO Jerramungup).

A specific fire interview form was developed in consultation with the steering group, but was only used in a couple of interviews, as understanding of the key issues evolved. It is shown in Appendix

Detailed fire histories – Timelines

A detailed fire history has been prepared for each fire. Each combines any references, interviews, extent maps and photographs supplied. We have tried to pick out key events, and instances of fast attack.

In the case of both the Cascade-Scaddan and Waroona Fires, a great deal of information has been extracted from the very detailed timelines in those reports. (No reason to re-invent the wheel). The O'Sullivan fire has less information, but we have also based our timeline on this.

Timelines for the Stirling Range fires use interviews, backed up with fire progress data, the photographs supplied, and satellite images. The Bremer bay fire timeline uses interviews, backed up with fire progress data and a couple of satellite images.

Fire Overviews

Each fire timeline has been condensed to extract a single set of the most relevant information, shown below:

Fire Date
Cause
First Report/Elapsed Time
Initial response
First Responders
Elapsed time from Report to initial response
Effectiveness of Response
Reason
Was a Fast Attack Possible?
Key Events
Other factors
Result

Figure 5 - Overview information selected for each fire.

The Overview also contains information for three secondary fires that occurred near and concurrent with the main fires studied – a small fire near and slightly before the Cascade Scaddan Fire, a fire (Fire 69) next to the Waroona Fire; and a Fire on Toll Peak at the same time as the Mt Success fire. The really important thing about each of these small fires is that they were each subject to a successful fast attack. In the case of the Waroona Fire 69, it was the major reason the Waroona fire was NOT ground attacked early.

RESULTS

Satellite Hotspots

The satellite hotspots were used to create the progressive outlines, where each successive layer was assessed for its coverage and timing. In these figures we have overlaid all layers to show the datasets. Accuracy varies between satellites, and not all layers have been used.

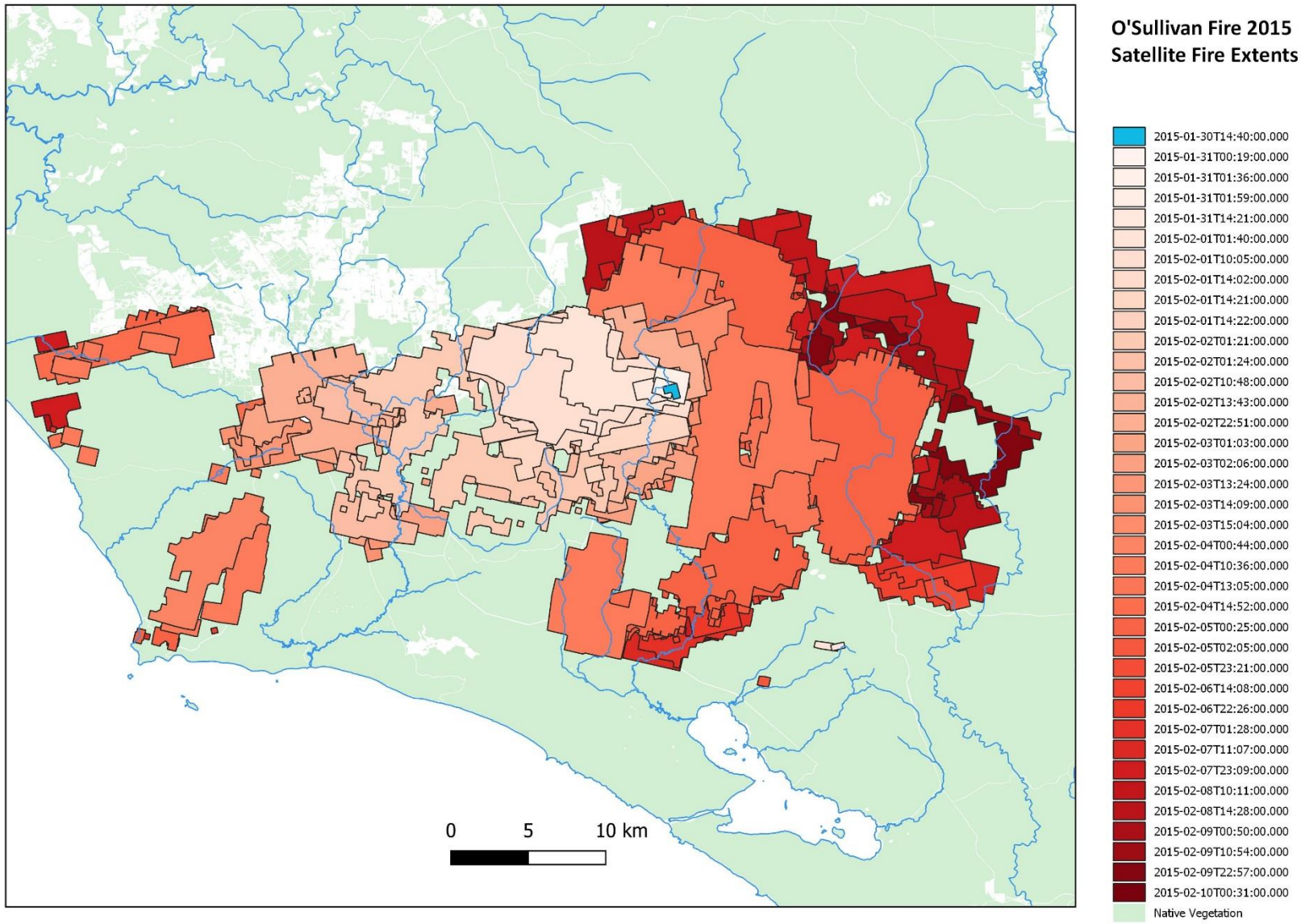


Figure 6- Progressive Fire Extents – O'Sullivan Fire Raw MODIS Extents.

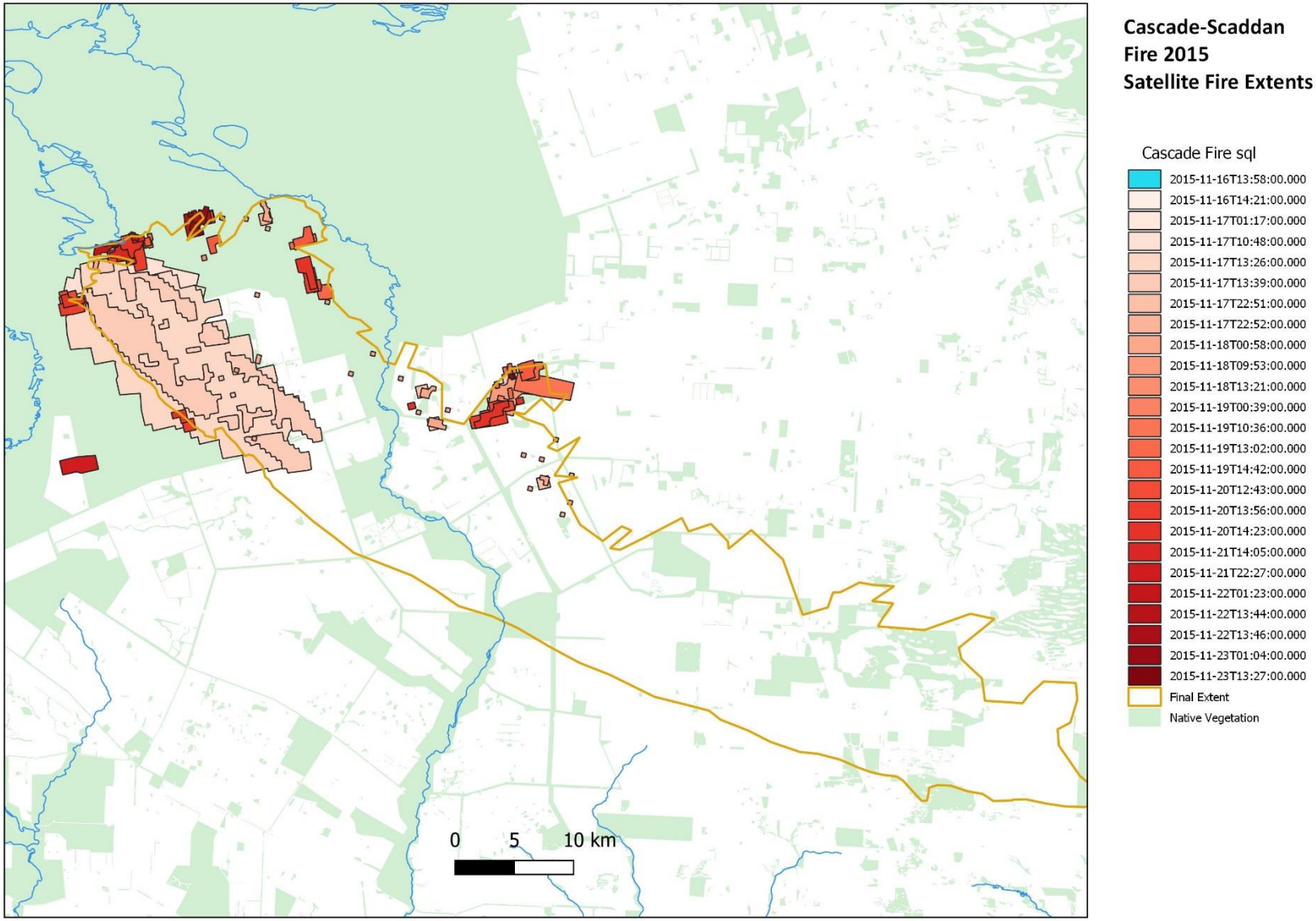


Figure 7 - Progressive Fire Extents – Cascade-Scaddan Fire Raw MODIS Extents

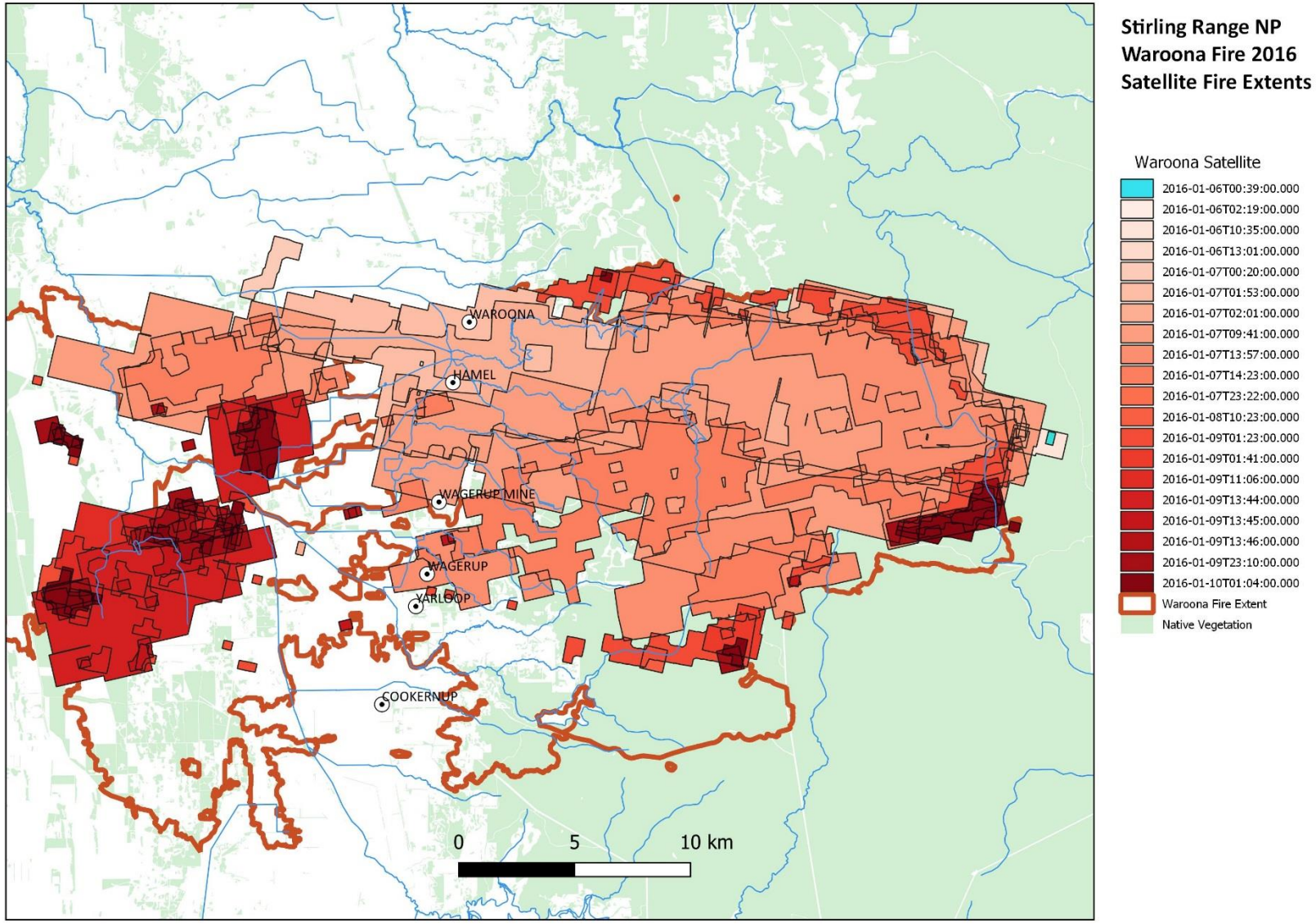


Figure 8 = Progressive Fire Extents Waroona Fire Raw MODIS Extents

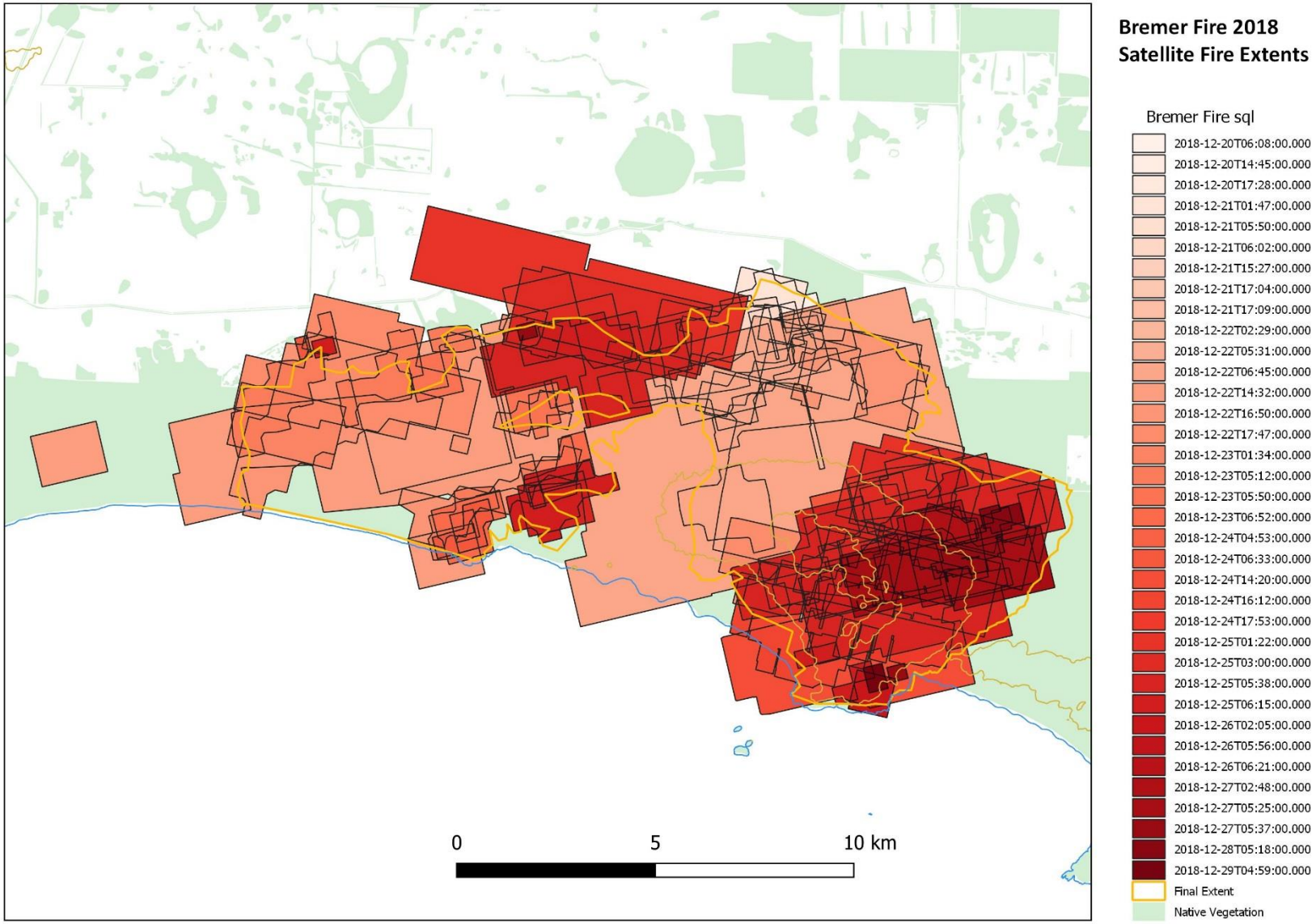


Figure 9 - Progressive Fire Extents – Bremer Bay Fire Raw MODIS Extents

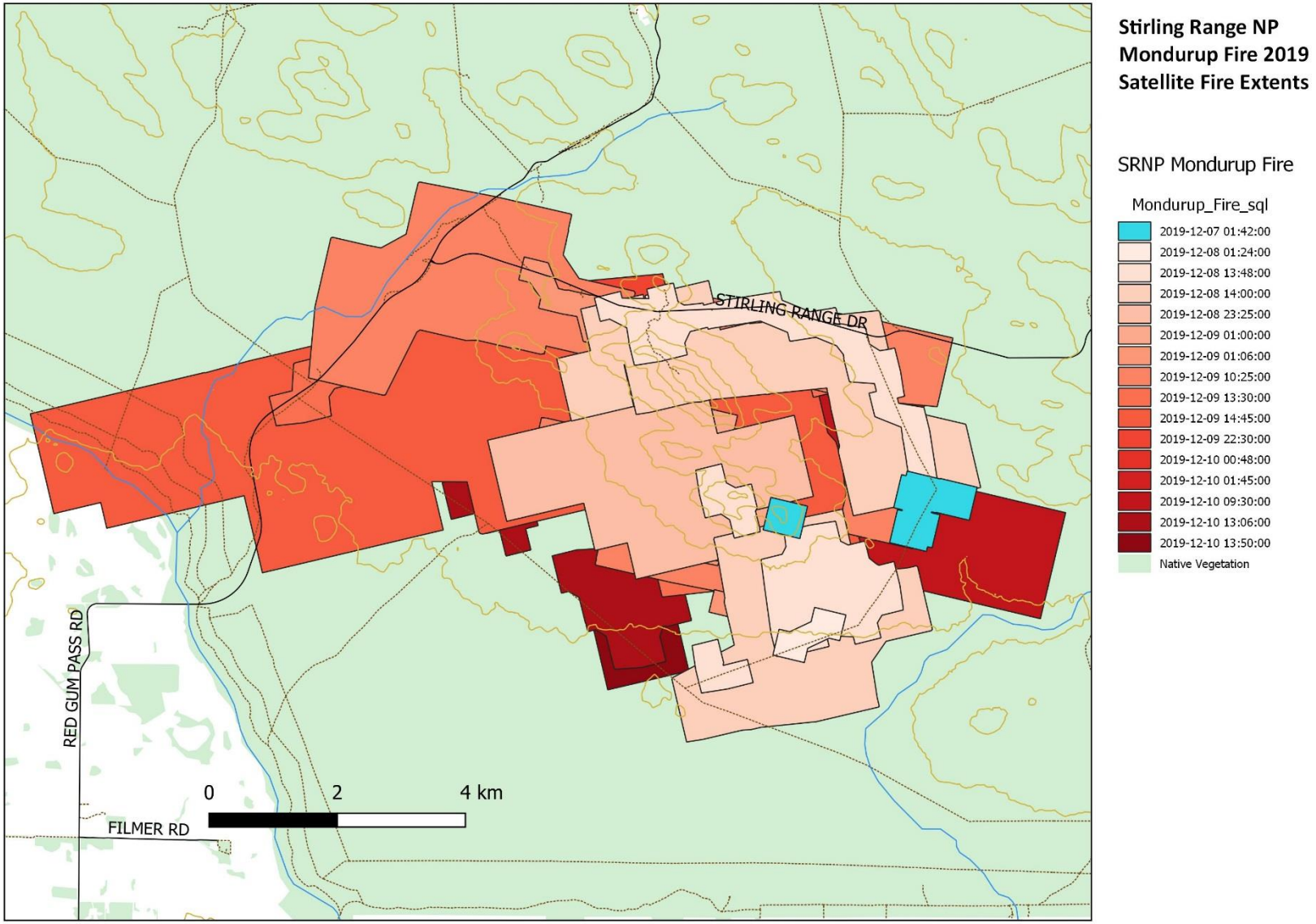


Figure 10 - Progressive Fire Extents – Mondurup Fire Raw MODIS Extents

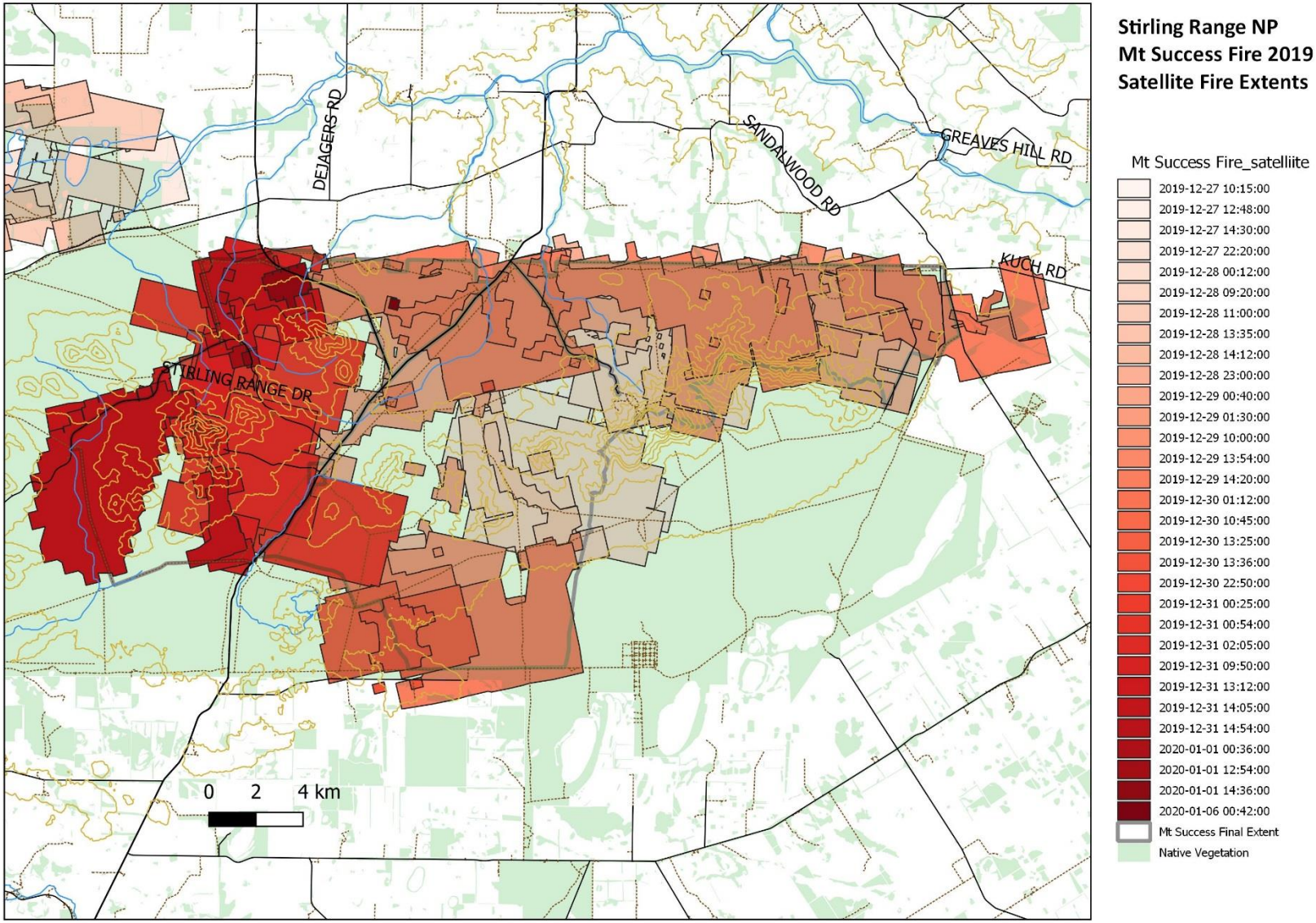


Figure 11 - Progressive Fire Extents – Mt Success Fire Raw MODIS Extents

Progressive Fire Extents

The progressive fire extents were drawn as polygons in shapefiles in QGIS, and are incorporated in the final timelines. For each fire, the final set of shapes is shown.

O'Sullivan

As the O'Sullivan FESA report had a series of progressive fire extent maps, we did not draw these maps. The FESA fire extents are shown below, and then the set of MODIS extents. The second figure shows how complicated the extents can be over time.

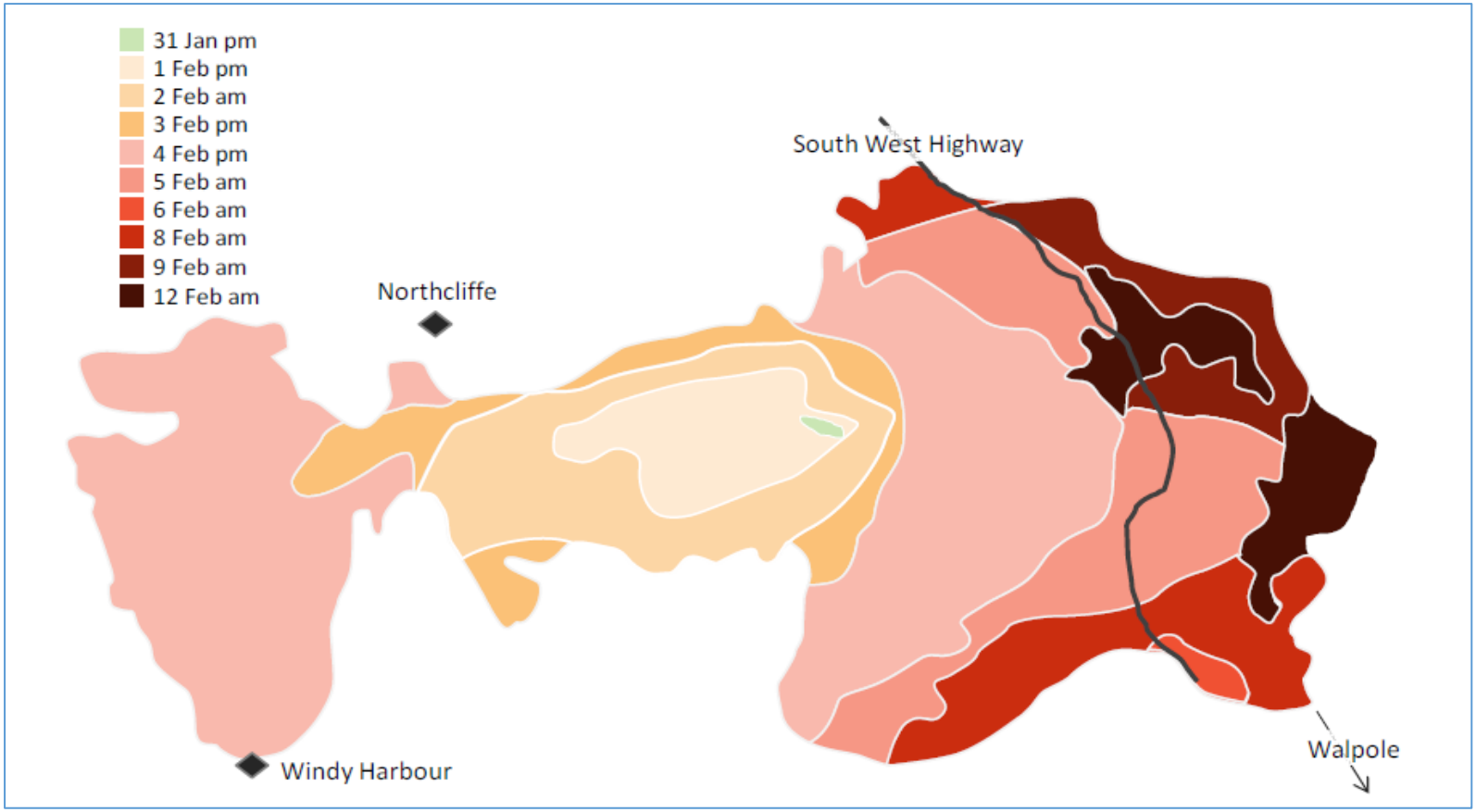


Figure 12 - Progression of the O'Sullivan Fire Shape – FESA Report Fig 5

Cascade Scaddan

The initial location of the Cascade-Scaddan fire is clear, and the first day's history relatively clear from maps in the reports. The subsequent movement of the fire was difficult to assess. The fire moved so rapidly (over 60km) on the day conditions were catastrophic – the 17th of November – that the actual location of the fire front is difficult to assess. However the overall outline is clear on satellite imagery, and the location of the fire on the afternoon of 17th November can be surmised from the timeline reports. This is shown in the figure below.

Figure 13 - Progressive Fire Extents – Cascade-Scaddan

Waroona

Waroona fire extents were digitised from mapping in the Inquiry report (McCaw et. al 2016). The map below only shows the fire for the first two full days up to the evening of Jan 7th. This fire is characterised by the misfortune of the two ignition sites; an extremely fast westward development during both the day and night of 6th of December, and then the spread to the south on the 7th of December.

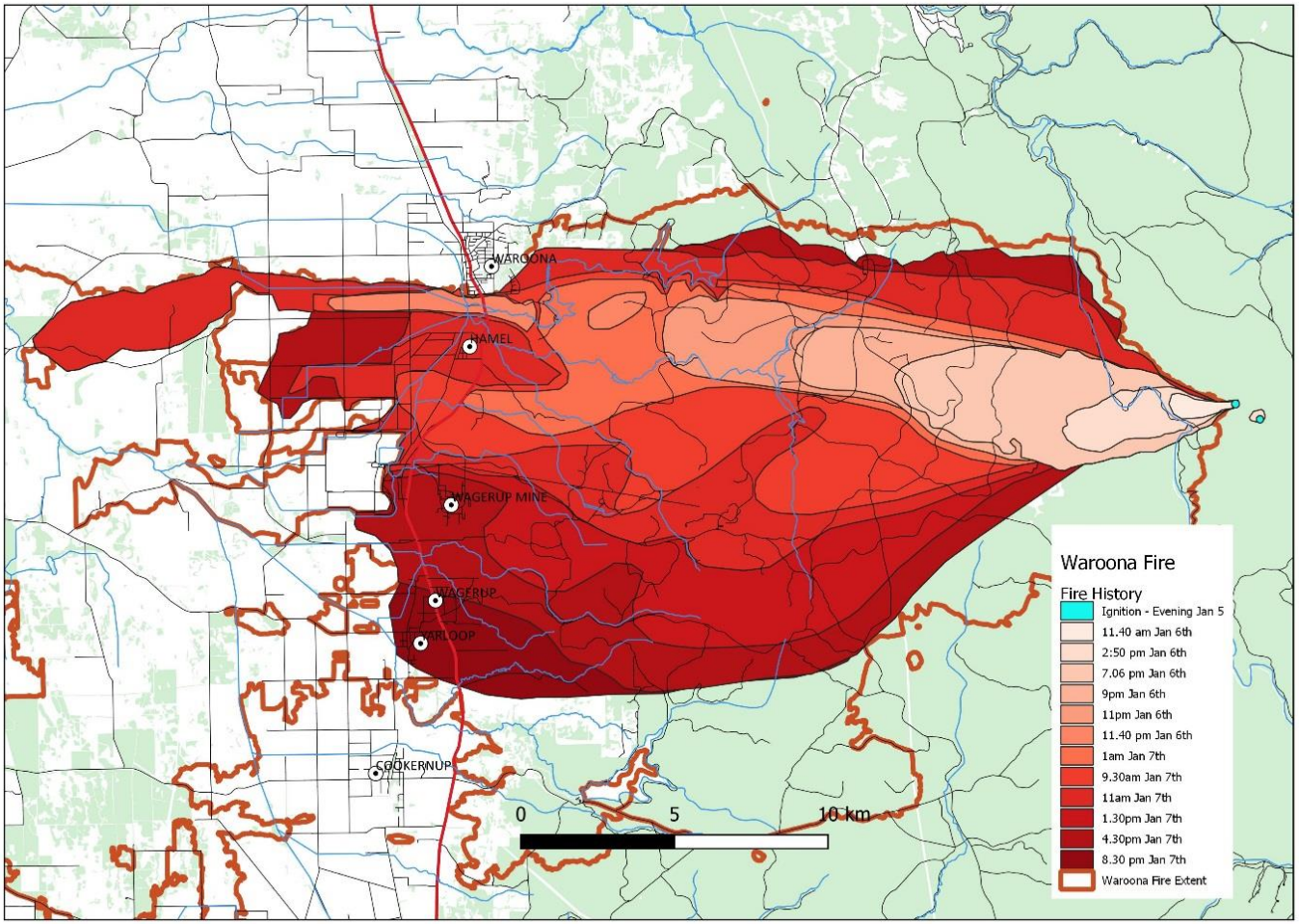


Figure 14 - Progressive Fire Extents – Waroona Fire

Bremer Bay

The Bremer Bay fire hotspot mapping is fairly clear form the MODIS images, and was aided by Sentinel images of extent from the 22nd. The initial development of the fire from source was relatively slow, but dramatic spread to the south-east and then the west on the 22nd are clear. A significant event in the progress of the fire was the later development to the west – when a fire-beak could not be constructed in time.

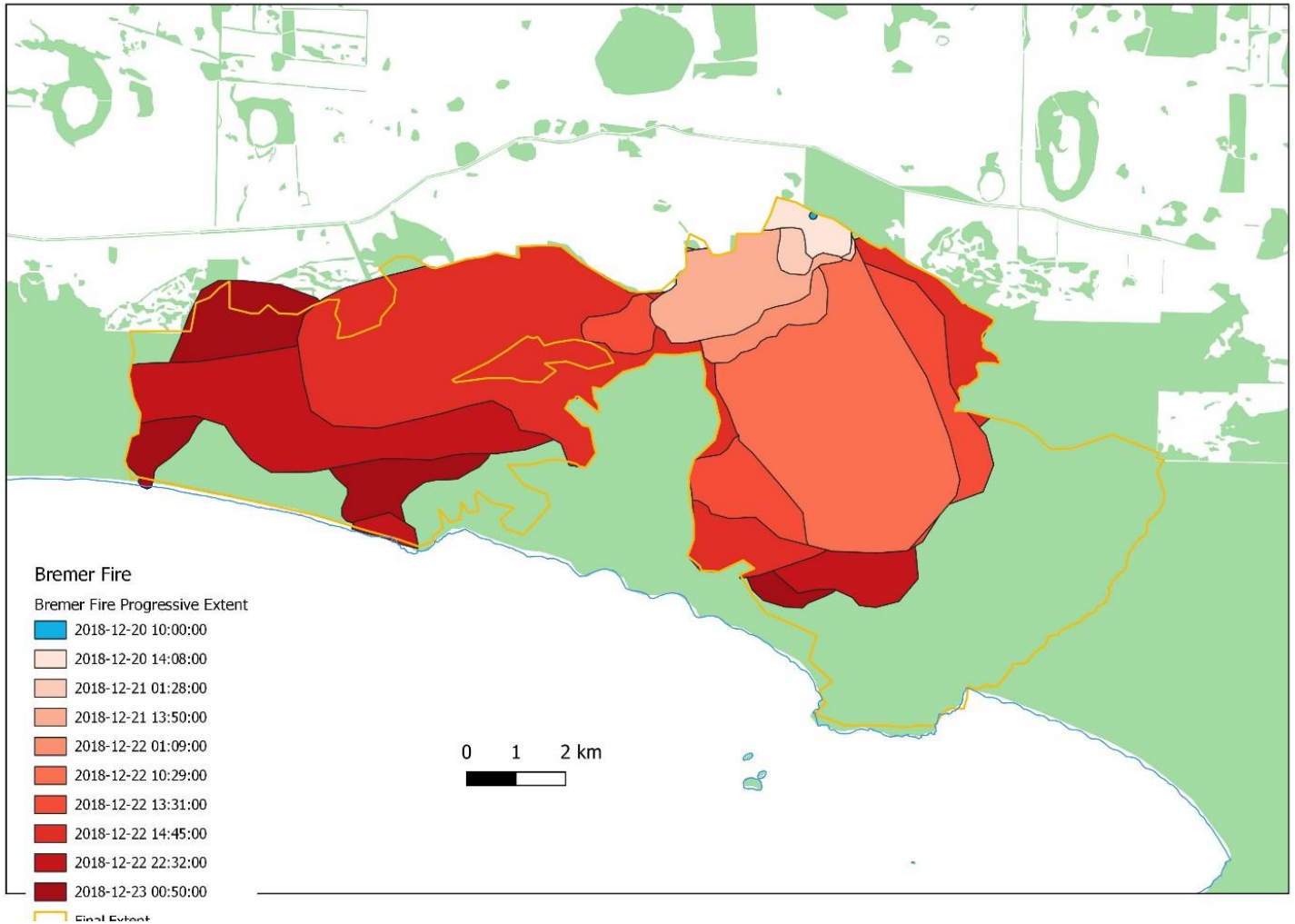


Figure 15 - Progressive Fire Extents – Bremer Bay Fire

Mondurup Stirling Range

The map below shows the progressive fire extents during the first 4 days and then the final extent. Fire development over days 1-2 is significantly based on photographs – this is especially true for the run off the peak during the morning of the 7th. Sentinel images provided accurate boundaries for the 10th December (fire development) and 15th Dec (final burn area), while the locations and extent of back burns was clear from the MODIS images.

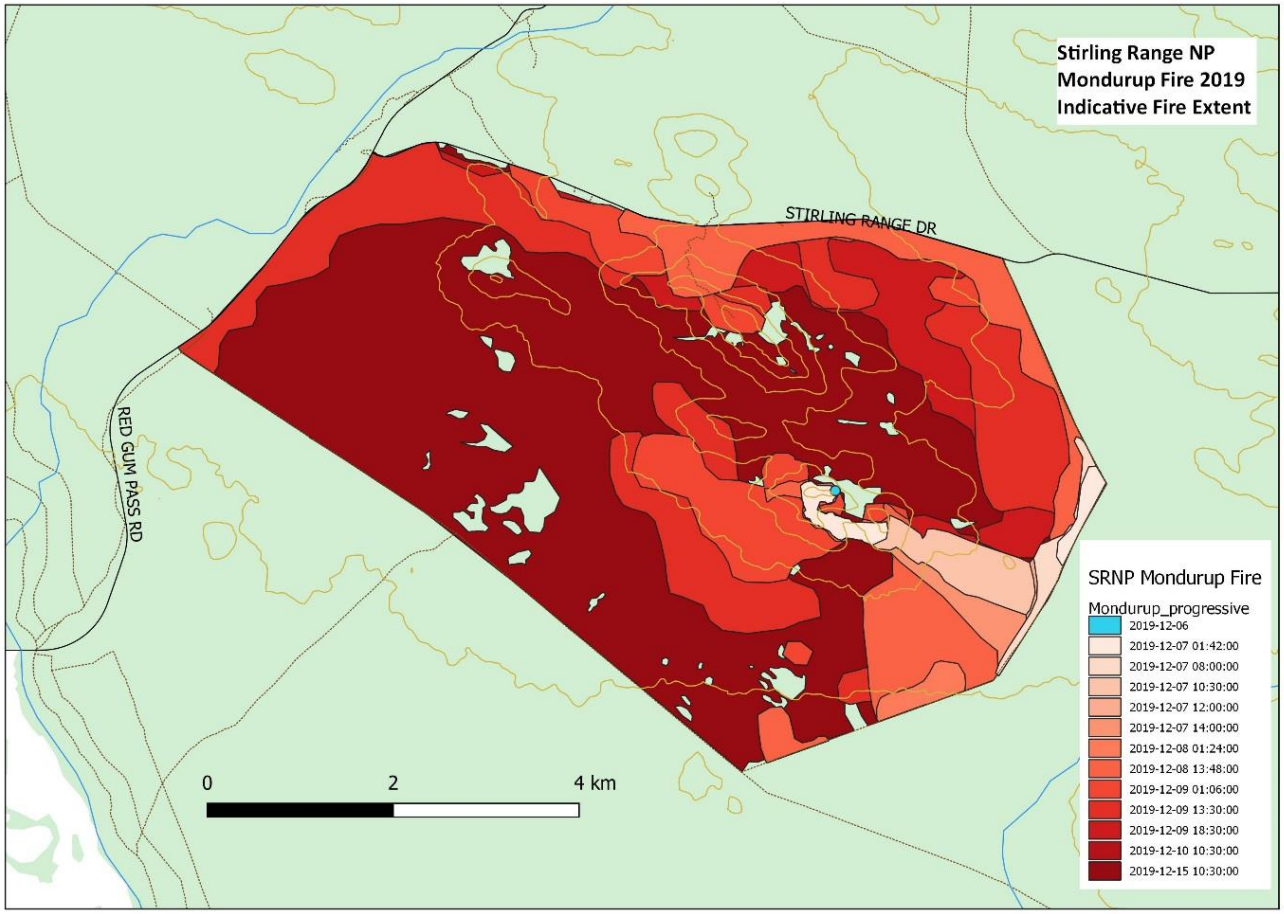


Figure 16 - Progressive Fire Extents – Mondurup Fire

Mt Success Stirling Range

The map below shows the progressive fire extents during the first 5 days and then the final extent. Most extents are taken from the MODIS images. The maps show the initial relatively even spread from the ignition point on the 27th, and then rapid spread on the 28th, including the escape across Chester Pass Rd in the afternoon. The escape out of the park on the east on the 29th can been seen also.

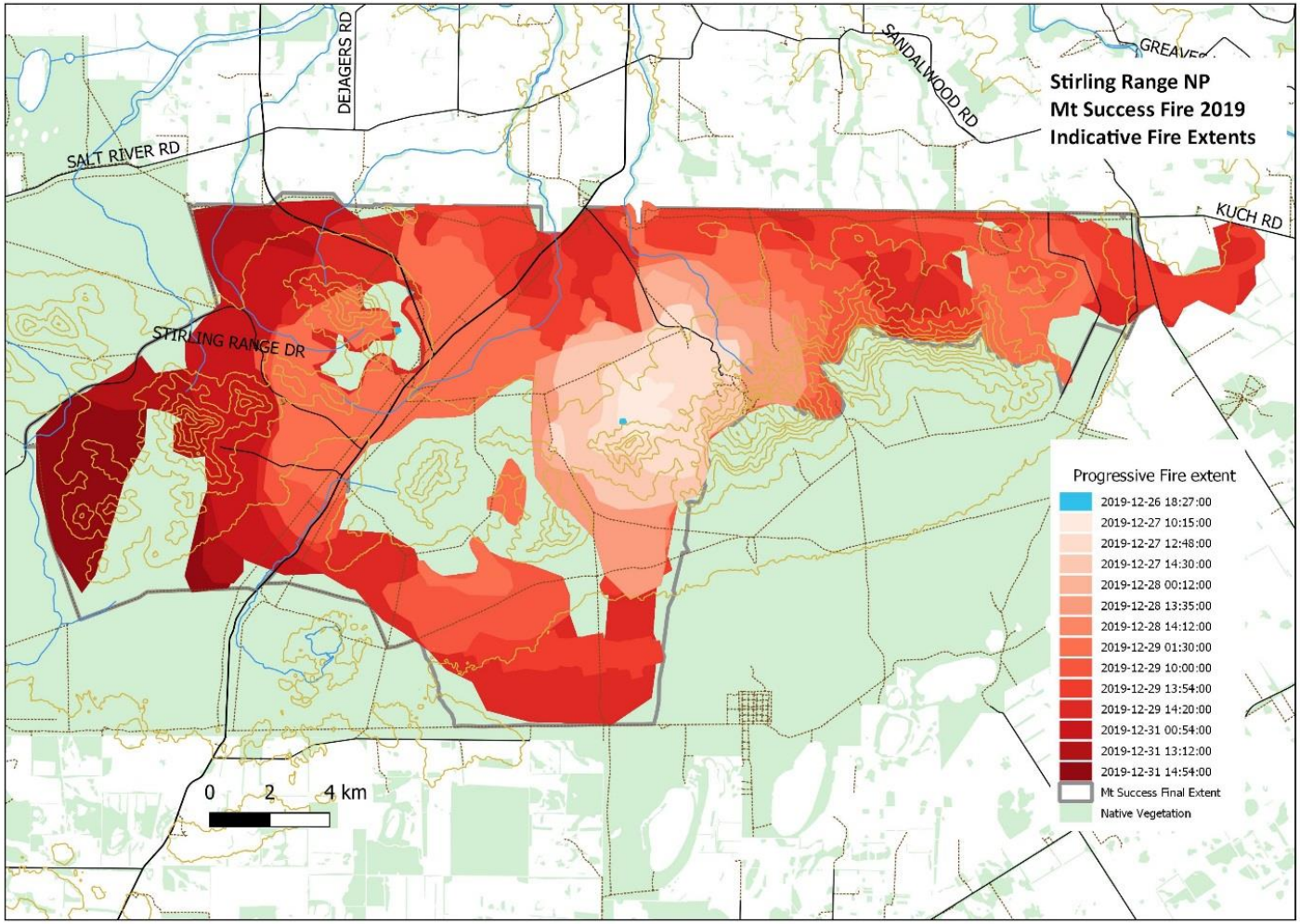


Figure 17 - Progressive Fire Extents – Mt Success Fire

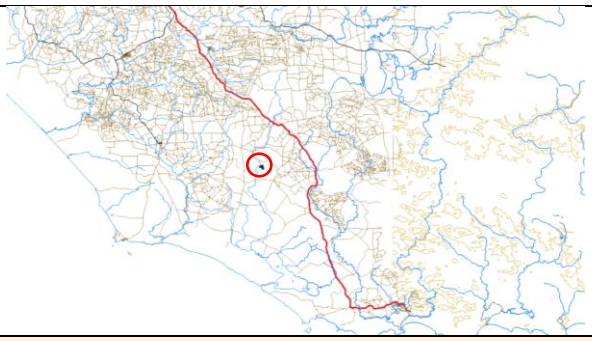
Fire Timelines

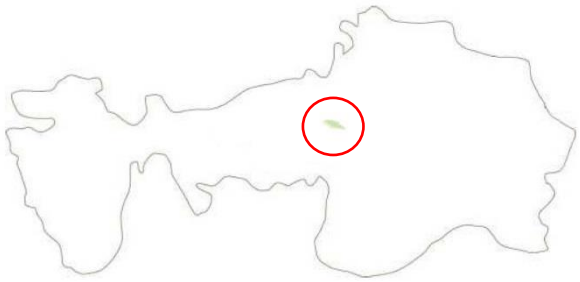
Fire timelines are listed chronologically:

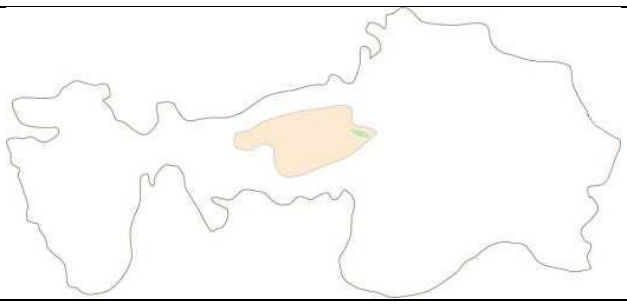
- O'Sullivan (Northcliffe) Fire – January 2015
- Cascade Scaddan Fire – November 2015
- Waroona Bushfire (Fire 68) – January 2016
- Bremer Bay Fire – December 2018
- Mondurup Fire – December 2019
- Mt Success Fire – December 2019

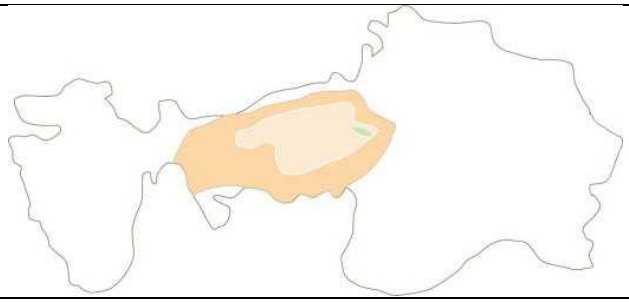
O'Sullivan (Northcliffe) Fire – January 2015

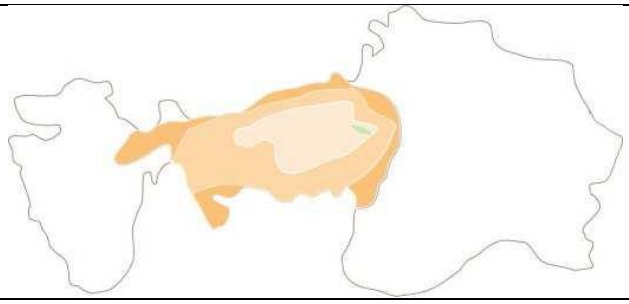
Extents are taken from the DFES incident report showing the approximate progression of the fire shape over time, based on fire shape maps contained in IAPs. (Nous Group 2015). The timeline is drawn from the DFES incident report, in turn "drawn from the Regional Situation Reports for the incident, the minutes of the OASG meetings and information provided through stakeholder consultation." (Nous Group 2015:10).

Time	Description		Weather
Wednesday January 28th 2015			
Day	Severe lightning strikes caused fifteen fires, of which the O'Sullivan fire was one. (In addition to these fires, the P&W Warren region was also managing four fires from other causes and eleven active prescribed burns.)		
Day	Fire was tiny, presumably smouldering, as yet undetected. No satellite trace.		
Thursday January 29th 2015			
0900	O'Sullivan fire remained undetected - presumably very small. No satellite trace (even with VIIRS/Suomi NPP 375m pixel satellite).		22.5 °C 77% hum, 14.8 km/h SW
1500			25.7 °C 61% hum, 22.3 km/h SSW
Friday January 30th 2015			
0955	O'Sullivan Fire spotted by air. (Department of Parks and Wildlife spotter aircraft to the Parks and Wildlife Pemberton Office.) The ignition occurred on a rocky outcrop in the vicinity of 5 year old fuels.		Shannon 9am 22C 70% hum 18.4 km/h SE
1000	P&W was the first agency to respond to the fire in Shannon National Park. 2 x fixed wing 802 Air Tractor water bombers and 1 x air attack supervisor in a fixed wing American Champion Scout were on site.		
	According to Nous Group (2015:11) "**Water bombing was successful in containing the initial blaze."**		
1440	First satellite trace of fire registers on the N satellite. (VIIRS/Suomi NPP 375m satellite). At the time of the satellite pass the fire is less than 50ha in size.		
	The terrestrial resources that responded are diverted to other fires burning in older fuels that are judged to pose a greater immediate threat to property and infrastructure. This decision is also likely to have been influenced by the fact that ground crews could not access the fire front until a track could be cleared.		
PM	An untimely break down of a contract bulldozer this afternoon, which was to be used to clear an access track, hampers the effort to make a direct attack.		3pm 30.7C 34% hum 20.5 km/h SE
Late PM	The incident is declared as Level 2, as part of a complex of fires in the region. A Level 2 IMT was formed to respond to the complex of fires.		

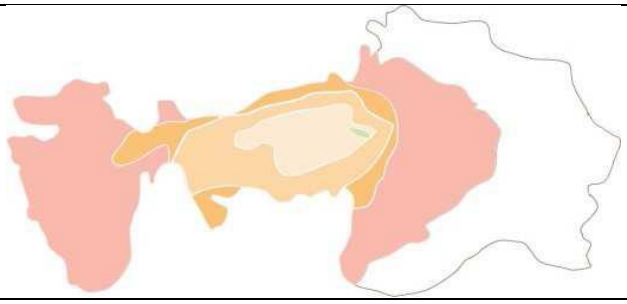
Saturday January 31st 2015			
	Note – Hotham fire re-ignited same day.		
AM	The O'Sullivan fire escalates through the course of 31 January. Initially very small, the fire increases in size during the day.		Shannon 9am 20.7C 62% hum 22.3 km/h ENE
1500			Shannon 3pm 28.4C 36% hum 27.7 km/h ENE
PM	An emergency warning is sent out for Shannon National Park. Under the influence of an ESE wind, spotting contributes to the westward advance of the fire towards Northcliffe.		North Walpole 3pm 25C 56% hum 25.9 km/h ESE
PM	Residents in the area of the national park are issued an Emergency Warning and advised to leave but most elect to stay and defend. The 2012 Babbington fire scar due south offers a valuable potential control barrier to the advance of the fire's southern flank.		
Evening	The decision is made to declare the incident as a Level 3 incident. Following the escalation to Level 3, control is transferred to DFES under section 13 of the Bushfires Act. P&W continue to provide significant support to the IMT, ground machinery and logistics. A strategic decision was made to focus direct attack on the northern flank of the fire, reflecting the threat to assets north of the fire.		
Night	The wind changes from ENE to E. The fire crosses Bannister Road and later Muirillup Road North. By midnight the fire is crowning and spotting up to 200m ahead of the main front.		E

Sunday February 1st 2015			
Early AM	In the early hours of 1 February the wind shifts back to ENE and picks up in strength as the fire makes a series of jumps over the Canterbury River.		Shannon 9am 20.6C 59% hum 29.5 km/h ENE
	Fire grows in size and spreads in a westerly direction. It is approaching 10,000 ha by end of day.		
1200	Emergency warning for E Northcliffe and later entire town (remains in place until 4/5 Feb).		Shannon 26C 39% hum 24.1 km/h E
1500			Shannon 3pm 29.2C 31% hum 20.5 km/h NE

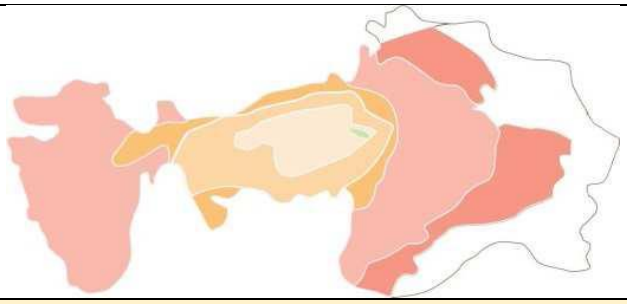
Monday February 2nd 2015			
AM	Wind speeds of 30km an hour with 50km gusts lead to markedly more severe fire intensity. A breakout from the NW boundary of the fire places eastern Northcliffe under threat and an Emergency Warning is issued for the area.		E – NE 30km, gusts to 50km.
0900			Shannon 9am 20.9C 63% hum 22.3 km/h NE
Noon	Many roads had already been closed and a community meeting was held at 12pm in Northcliffe.		31.8C 29% hum 22.3 km/h N
PM	The fire spreads rapidly and passes south of Northcliffe, crowning with over 40m flames in karri forests. An unoccupied farmhouse, fences and pasture and lost. Police go door to door in Northcliffe advising residents to evacuate. Fire reaches 20,000 ha		
Afternoon	Fire jumps Chesapeake Road moving SW. At the same time there are reports of a breakout in the NE corner of the fire, heading towards the South West Highway. As in the case of the Lower Hotham fire, the intensity and scale of the O'Sullivan fire appears to create its own conditions, with behaviour inconsistent with predictions in its most active phases.		
1500			Shannon 3pm 30.1C 35% hum 13 km/h NNW
Overnight	Fire crosses Windy Harbour rd.		

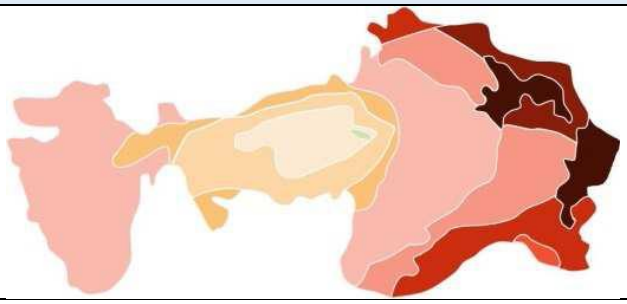
Tuesday February 3rd 2015			
Overnight	Windy Harbour Road closed before daylight on 3 February.		
0900			Shannon 9am 28.4C 45% hum 9.4 km/h NE
1200	Community meetings being held in Pemberton & Northcliffe (every day till 7th).		
PM	Fire greater than 30,000 ha.		Shannon 34.1C 23% hum 11.2 km/h NNE
	On the east side of Windy Harbour Road the advance of the long southern front is halted by the 2012 Babbington fire scar. On the west side of Windy Harbour Road however, the fire continues west and south.		

1500			Shannon 3pm 34.3C 29% hum 20.5km/h S
PM	On the afternoon of 3 February an emergency situation was declared by DFES under the Emergency Management Act 2005.		

Wednesday February 4th 2015			
Early AM	A Watch and Act warning is issued for Windy Harbour.		21.1C 65% hum 9.4 km/h NNE
9am			Shannon 9am 28.7C 39% hum 16.6 km/h NNE
AM	The NE breakaway which had begun on 2 February advances closer to South-West Highway on the morning of 4 February and priority is given to protecting the Highway's timber bridges. Soon after, retardant is used on the bridges and the Highway is closed. The fire jumps over SW Highway after a NE breakout.		
Noon			33.4C 23% hum 25.9 km/h NNW
PM	Fire Status		
Afternoon	Windy Harbour Watch & Act upgraded to an Emergency Warning.		
PM	As the wind shifts SW, Pemberton is issued an Advice level warning and the hospital is evacuated. A Watch and Act warning is issued for Quinninup. Walpole is also issued an Advice warning, which is later elevated to Watch and Act in light of the fire making several jumps over the South West Highway. A community meeting in Northcliffe was scheduled for 2pm but cancelled due to an unacceptable risk level.		
3pm			Shannon 3pm 29C 50% hum 5.4 km/h NNE
PM	The fire's movement towards Windy Harbour destroys one unoccupied residential house and a farm shed. The advance of the fire south west also destroyed three dwellings on private property at Malimup Springs.		SW
Evening	Southern front advances overnight towards Windy Harbour.		
Night	Deployment of Victorian resources commenced on the night shift of 4 February.		

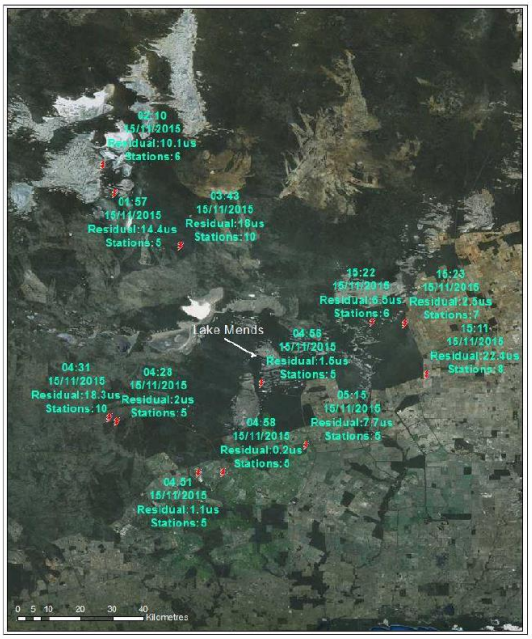
Thursday February 5th 2015			
9AM	The wind shifts back to NW and favourable weather conditions are forecast for the remainder of the week.		NW Shannon 22.8C 72% hum 11.2 km/h NNW
	The active fire of the previous night around Windy Harbour had been contained.		
3PM	Cool change comes in, humidity rises and wind turns to SW.		Shannon 19C 101% hum 16.6 km/h SW

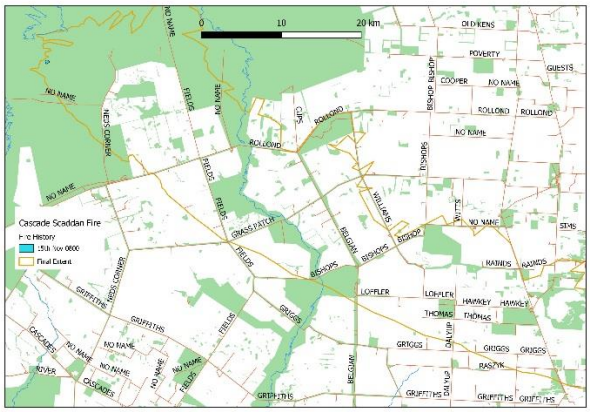
PM	SW spread halts, Eastern spread continues. Efforts continue to contain the NE breakout across South West Highway and the western front of the fire.		
	The expansion of the Fire slows dramatically during the day. 5th February marks the end of the most active phases of the fire. Fire up to 80,000ha in area.		
Evening	As the threat was subdued warnings for Windy Harbour and Northcliffe were downgraded to Watch and Act in the evening.		

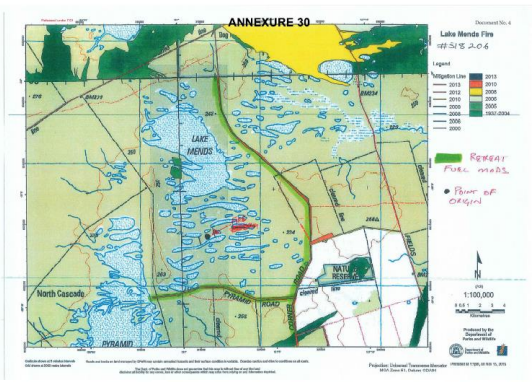
Friday February 6th – Thursday February 12th 2015			
	Significant IMT changeover occurred on the day shift of Feb 6, as P&W transitioned from their red team to their green team.		
6th – 11th	Joint IMT, comprising DFES, P&W and LG personnel continued throughout the incident. Over the period through to 11 February a further 15,000 hectares are burnt, some of which consisted of back burning to protect Walpole, pocket burning to protect Windy Harbour and edging to strengthen containment lines.		
	Fire crews deal with many spot fires and hop overs during this phase, some of which were accessible by air only. Strategic retardant drops were used to ensure the robustness of containment lines. For the most part the fire was held within containment lines.		
Thursday 12thFeb.	Full extent of fire reached.		

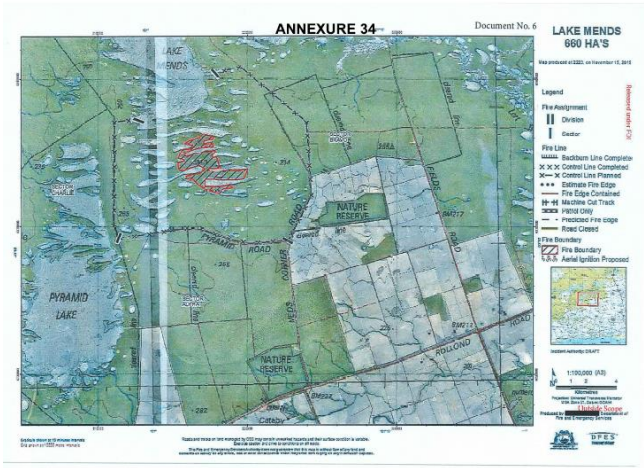
Cascade Scaddan Fire – Sunday 15 November 2015

Fire extents shown in this timeline are indicative: they are taken from different satellite sources, and with low resolution data (VIIRS/Suomi NPP 375m satellite or MODIS Aqua & Terra Satellite) in most cases. Not all fire extent may be mapped due to the time fires grew and the satellite passes. The timeline is taken principally from the Pacer Legal (2016) report, with additional information form the Coroner's Report (Linton 2018) and the DFES review (Nous Group 2016).

Time	Description	Map	Weather
			ESPERANCE weather – 125 km SE of ignition point
Sunday 15 November 2015			
0500 approx	Lightning struck on UCL south of Lake Mends and north of Cascade.	 **References** Abarca, S. F., K. L. Corbosiero, and T. J. Galarneau Jr. (2010), An evaluation of the Worldwide Lightning Location Network (WWLLN) using the National Lightning Detection Network (NLDN) as ground truth, J. Geophys. Res., 115, D18206, doi:10.1029/2009JD013411. 65 Brockway Road, Floreat, Western Australia 6014 Tel: (08) 9387 0330 Fax: (08) 9383 7142 Email:Mike.Steber@landgate.wa.gov.au www.landgate.wa.gov.au	18.5C 59% hum 24.1 km/h NNE
0700	Approx first sighting – first spot fire		
0700-0800	A small spot fire about 200 meters in from the boundary of the UCL and farmlands was contained by the local farmers and members of the local Bush Fire Brigades (BFB), being the Cascade and Munglinup BFBs. Operations were under the direction of the Mr Carmody - Deputy Senior Bush Fire Control Officer of the West Zone/ Captain of Cascade BFB (Commanding Fire Control Officer). Equipment used included local farmers' equipment and 3 Heavy Units sourced from the Cascade and Munglinup BFBs. The spot fire was contained by the Carmody brothers put a mineral earth break around the fire using a Loader, and was extinguished about an hour later by the Cascade and Munglinup BFBs.		
0800	The Commanding Fire Control Officer (CFCO) reported containment of the first spot fire to locally based DFES personnel (DFES Area Officer).		
0900	The CFCO was informed that there was smoke coming from a different location in the UCL.		28.8C 26% hum 22.3 km/h N
	DFES Area Officer was notified that		

0930-1030	The CFCO assessed the situation from the air in a private plane. The Commanding Fire Control Officer updated the DFES Area Officer of the situation observed. At this time, the Commanding Fire Control Officer reported that another spot fire was contained but too far into the UCL for the farmers to access with their own equipment (Fire). The DFES Area Officer confirmed that he would arrange a helicopter from Esperance, with Department of Parks and Wildlife (DPaW) staff on board, to collect him and to undertake a reconnaissance of the area later that day.	 Photogaph taken from private plane, 0958 (Pacer Legal 2016:9)	
0958	Location of initial fire as assessed from photograph above.		
1107	A picture taken of the Fire from Neds Corner Farm. (Pacer Legal 2016:10)		
1114	The Bureau of Meteorology (BOM) issued a Spot Fire Weather Forecast for the "Lake Mends/ Scaddan Fire" (Spot Fire Weather Forecast 1). This predicted: • a maximum temperature of 37°C and wind gusts of up to 70–80km/hr that day; • 34°C with a minimum humidity of 25% and wind speeds between 5-10km/hr for Monday 16 November 2016 ; and • 41°C with a minimum humidity of 10%. With Wind speeds were forecasted to be between 20-30km/hr for Tuesday. The conditions are worse than Esperance actuals shown in this table – e.g. on Sunday Esperance had a maximum of 35.1 and winds below 30km/h; while on Monday Esperance had a maximum of just 20.6 degrees. On Tuesday however conditions are similar.		
1200	The Commanding Fire Control Officer and DFES Area Officer established PLAN A. PLAN A was for Bulldozers A, B & C to create a track through the bush on the UCL to the Fire during the night so that the Fire could be accessed and contained on Monday morning. Intention was to contain fire by 12:00 on Monday the 16th; and re-treat fuel breaks on adjacent roads. The Commanding Fire Control Officer instructed the Operator of 'Bulldozer A' (Operator A) to mobilise to the Fire Ground. Operator A was advised by the DFES Area Officer to take instructions from the Commanding Fire Control Officer. Operator A commenced mobilisation of Bulldozer A to the Fire Ground.	34.5C 21% hum 20.5 km/h WNW
	During this time the CFCO discussed with the DEFS Area Officer "the availability of aerial water bombers as well, but Mr Wornes (DFESAO) indicated he didn't think they would be available due to the other incidents in the South West." (Linton 2019:13).		

	Local agricultural aircraft that were available and capable of doing water bombing were not permitted to take on the task for various reasons. (Linton 2019).		
1235	A DPaW 'Initial Fire Report' was completed (Initial Fire Report). The Initial Fire Report refers to the Fire as the 'Lake Mends' fire, and as fire number "318206".		
1310	A DPaW map was produced (DPaW Map 1).DPaW Map 1 indicates the "point of origin of the Fire" and where to "re-treat fuel mods".		
1411	A picture of the Fire taken from Ned's Corner Farm. (Pacer Legal 2016:12)		
1430	Operator A and Bulldozer A arrived at the Fire Ground.		
1430-1630	Operator A waited for instructions and arranged for a grader to be mobilised. Meanwhile Operator B was contacted by the DFES Area Officer and asked to mobilise. Operator B advised that Bulldozer B had broken down earlier that afternoon and was not available for mobilisation until after repairs had been undertaken. Operator B anticipated being able to mobilise the following morning.		
1600-1630	The Commanding Fire Control Officer and 2 DPaW personnel observed the situation from a helicopter. Their observation at this time was that the Fire had spread dramatically during the course of the day. Multiple fire fingers now existed throughout the UCL, presumably created due to strong southerly winds throughout Sunday afternoon. Their observation was that PLAN A was no longer viable as the Fire had spread too far and too many fire fingers had been created. *During the course of this flight, the CFCO was advised by the DPaW personnel that they were stretched and were not in a position to operationally control the Fire.*	 1621. A picture of the Fire taken from the helicopter. (Pacer Legal 2016:13).	24.6C 49% hum 22.3 km/h S
1613	BOM issued a Fire Weather Warning (Fire Weather Warning 1). Fire Weather Warning 1 forecasted "Severe Fire Danger" for the Goldfields District on Monday.		
1630	The Commanding Fire Control Officer contacted members of various BFBs to notify volunteers of PLAN B, and to request and arrange for their assistance to implement PLAN B the following day.		

1711	A second DPaW map was produced (DPaW Map 2) which illustrates the location of 10 fires then burning in the Esperance region.		
1800-2100	Operator A arrived at the end of Pyramid Road with Bulldozer A. Operator A cleared Pyramid Track in a westerly direction. Pyramid Track was in a poor condition and did not appear to have been cleared for at least 10 years. (Pyramid Track could only be accessed by 4WD vehicles prior to Bulldozer A clearing it.)		
2130	The Commanding Fire Control Officer instructed Operator A to cease works and to return to the Fire Ground at 07:00 on Monday.		
2223	DPaW Map 3 illustrates the estimated location of the Fire and the location of the existing firebreak that was to be freshened up in accordance with PLAN B/ Strategy Option 2. (Pacer Legal).		
2220	Progressive Fire Location – taken from Map 3 above.		

Monday 16 November 2015			
0600	Progressive Fire Location from MODIS imagery.		

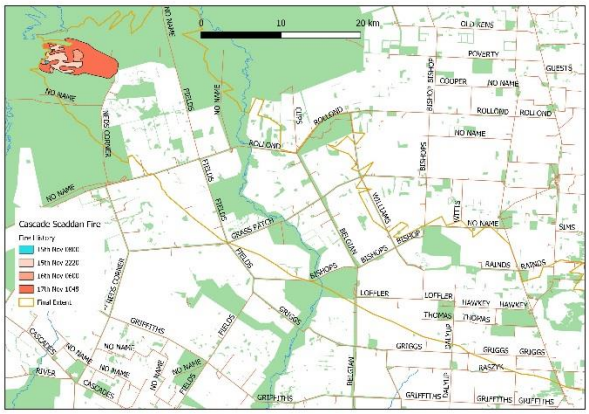
0630-0730	The Commanding Fire Control Officer assessed the situation from the air in a private plane. His observation at this time was that the Fire had died down significantly overnight. "He took photos of the Cascades fire and it appeared almost completely subdued, with just one remaining spot fire." (Linton 2019:10) The picture of the Fire was taken from the private plane at 0658. (Pacer Legal 2016:16).		16.3C 87% hum 13 km/h SSW
0700	Photograph taken by Mr Carmody (CFCO) from his plane at 0700. (Linton 2019:16).		
	PLAN C was established by the Commanding Fire Control Officer and the DFES Area Officer. PLAN C was to have farmers, with paddocks in crop on the boundary of the UCL, harvest low to the ground and thereafter plough over that ground in order to create an additional firebreak. (PLAN C was to be implemented in addition to PLAN B). The objective of PLAN A was also revised by the Commanding Fire Control Officer and the DFES Area Officer. REVISED PLAN A was to drive a bulldozer directly to the fire and then track the fire so that should the fire escape, the size of the fire front would be reduced. REVISED PLAN A was only going to be viable as long as the weather permitted.		
0900	The Commanding Fire Control Officer requested Water Bombers. The DFES Area Officer confirmed that Water Bombers were requested the previous day, but that none were available. The DFES Area Officer confirmed that Water Bombers would be requested again that day. The Commanding Fire Control Officer confirmed that if he couldn't have Water Bombers he needed some other form of aircraft so that he could observe and monitor the movements of the Fire.		19.9C 64% hum 16.6 km/h S
0900	In circumstances where Bulldozers B & C would not arrive before the wind direction changed, the Commanding Fire Control Officer instructed local farmers and volunteers to source private machinery so that when the chain arrived further works on PLAN B could immediately commence.		
0900-2300	Local farmers/ volunteers utilised private machinery for the purposes of implementing PLAN C (Harvest & Plough Crew). The Harvest & Plough Crew harvested crops planted on the boundary of the farmland and the UCL to the ground, to a width of approximately 300m. Thereafter they ploughed the ground over this area. This type of firebreak was installed over approximately 15kms of boundary farmland.		
1100	The chain arrived.		
1100-1700	Local farmers and volunteers hooked the chain between a private loader and a private tractor (Chaining Crew) and commenced further works on PLAN B. The Chaining Crew commenced chaining the existing firebreak at the northern end of Neds Corner Road, at the start of the farmland. They chained from their starting point in a southerly direction to the intersection of Neds Corner Road and Pyramid Road, and thereafter chained in a westerly direction along Pyramid Road, towards the commencement of Pyramid Track. The condition of the existing firebreak was very poor.		
1050	BOM issued an Emergency Services Weather Briefing forecasting "Severe Fire Danger" for the Goldfields District that day and "Extreme Fire Danger" for the Esperance Shire Inland District on Tuesday.		
Late AM	The Incident Control Van (ICV) was delivered to the Fire Ground. The ICV was set up on high ground where the Commanding Fire Control Officer and local farmers thought the ICV would have the best communication signal and line of site. The ICV site was also situated where a helicopter could land. The ICV had maps and it was intended that the ICV would receive updated information from helicopters when they returned from their trips. Local farmers and volunteers were able to drop into the ICV for updated information and instructions.		
1130	The Commanding Fire Control Officer recorded weather observations. The temperature was 30°C, relative humidity was 34% and winds were 7km/hr coming from the south east.		
1200	Esperance weather observations: much cooler and more humid. Winds higher on the coast however.		20.1C 64% hum 24.1 km/h SE
1230	The Commanding Fire Control Officer assessed the situation from a private plane. The Commanding Fire Control Officer observed that fire activity had increased and there were now numerous hot spots.		

1230	One of the Chaining Crew machines broke down. The Chaining Crew ceased work on PLAN B.		
1238	Fire photographed from the private plane – multiple areas of activity can ben seen. (Pacer Legal 2016:19).		
1300	Due to a bulldozer breakdown, the CFCO was informed that the Chaining Crew had ceased operations and that no replacement machine had been located. CFCO considered PLAN B to have failed at this point as it was going to be too late to conduct the back-burn by the time Bulldozer C was mobilised and Operators B & C could recommence chaining works on PLAN B. REVISED PLAN A became crucial.		
1359	Fire photographed from the helicopter.(Pacer Legal 2016:19)		
1200	The Commanding Fire Control Officer and 2 DPaW personnel assessed the situation from a helicopter. The Commanding Fire Control Officer observed that the Tracking Crew working on REVISED PLAN A had missed the right turn that the Commanding Fire Control Officer intended the Tracking Crew to take onto the existing exploration drilling track. Personnel in the helicopter could not communicate with the Tracking Crew from the helicopter.		
1414	A picture of the Fire taken from Neds Corner Farm. (Pacer Legal 2016:20)		
1430	The helicopter landed. The commanding Fire Control Officer drove to the Tracking Crew and redirected them to the existing exploration drilling track which provided a more direct path to the Fire.		
1440	DFES Area Officer was advised that water bombers were not available as they were being used in Albany.		
1430-1800	The Tracking Crew recommenced clearing along the existing exploration drilling track and arrived at the fire line at approximately 18:00. The existing exploration drilling track was in poor condition. The Tracking Crew experienced delays throughout the day due to various pieces of equipment getting bogged amongst lakes.		
1505	BOM issued another Fire Weather Warning. Fire Weather Warning 3 forecasted "Catastrophic Fire Danger" for the Esperance Shire Inland District on Tuesday.		
1600	BOM issued a Routine Fire Weather Forecast forecasting a "Catastrophic" rating and a Grass Fire Danger Index (GFDI) of 120 for the Esperance Shire Inland District on Tuesday.		18.2C 75% hum 24.1 km/h SE
1700	The Commanding Fire Control Officer assessed the situation from a helicopter with the Chief Bush Fire Control Officer for the Esperance Region (CBFCO) and the Deputy Chief Bush Fire Control Officer for the Esperance Region (DCBFCO).		

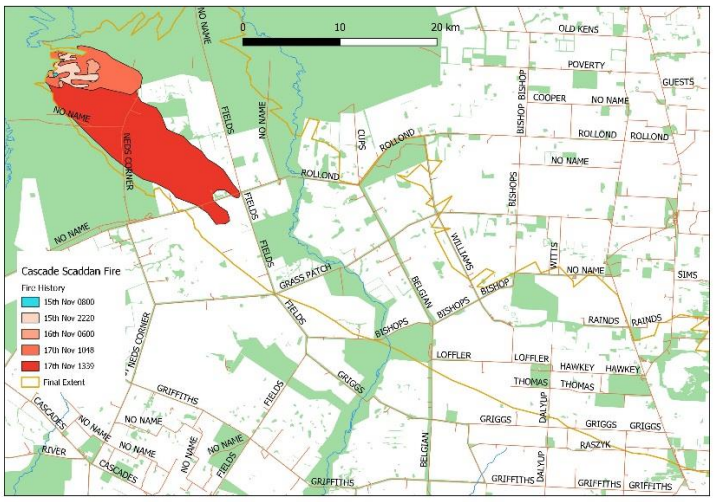
	The helicopter personnel observed that the Tracking Crew was making progress towards the fire line. The helicopter landed on a lake next to the Tracking Crew and took 2 members of the Tracking Crew up to view the Fire Ground and to indicate where the Commanding Fire Control Officer wanted them to continue creating an access track towards the Fire.		
1700-2100	Operators B & C, using Bulldozers B & C (New Chaining Crew) re-commenced work on PLAN B. The New Chaining Crew chained the existing firebreak which runs along the boundary of the UCL and Pyramid Road. The state of the existing firebreak was in poor condition and was extremely overgrown. The firebreak that was created by the end of the day was between 70m and 140m wide.		
1723	A second DPaW Regional Situation Report was created, which identifies the "Cascades Fire" as one of three incidents in the region *and as the third priority ("Incident 3"), after the other two incidents.*		
Afternoon	DFES Area Officer had been ringing DFES throughout the day requesting aerial water bombers and support personnel to assist with mapping, air intelligence, planning, logistics and administration. Concerns were raised about the fire continuing to be a local government fire, and the need for a harvest, machinery and vehicle movement ban the following day.		
Evening	Local Government contacted DFES regarding a Section 13 Request. A misunderstanding followed on from this conversation in that: (a) Local Government understood that control of the Fire had been handed over to DFES; but (b) DFES understood that Local Government was still in control of the Fire and that DFES were simply to commence preparing to take control of the Fire.		
1602	A picture taken from Bulldozer B whilst chaining with Bulldozer C along the existing firebreak on Pyramid Road. The bush in the foreground of the picture, being the area between the two bulldozers, is the existing firebreak. (Pacer Legal 2016:22).		
1800-2100	The Tracking Crew tracked the burnt fire edge in the Lake Mends area.		
2130	The Tracking Crew received instructions from the Commanding Fire Control Officer at the ICV. The Tracking Crew was instructed to return the following day at 07:00. Operators B & C were also asked to return at 07:00 the following day. The Commanding Fire Control Officer liaised with volunteers / farmers working on PLAN C. The parties planned to enhance PLAN B the following day.		

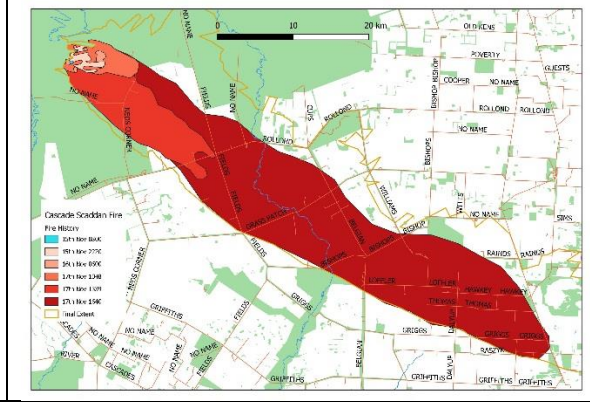
Tuesday 17 November 2015			
0331	BOM issued another Fire Weather Warning. Fire Weather Warning 4 forecasted "Catastrophic Fire Danger" for the Esperance Shire Inland District for the rest of Tuesday		
0526	BOM issued another Spot Fire Weather Forecast for Lake Mends predicting a maximum temperature of 42°C, with the conditions for the day to be hot, dry and very windy. Predicted wind gusts of up to 60-70km/hr during the afternoon and a southerly wind change around 20:00-21:00. The maximum GFDI that day was predicted to be 110.		
0600-0630	The CFCO assessed the situation from the air in a private plane and observed that the Fire had again died down significantly overnight.		15.7C 80% hum 11.2 km/h ESE

0617	*According to Pacer Legal, this is "A Picture of the Fire taken from the private plane." (Pacer Legal 2016:24).* *The photograph suggests an extremely low level of fire activity at this point.* *However according to the Coroners' Findings the photograph was actually taken by Mr Carmody (Deputy Senior FCO) from his plane at 7.00 am on Monday, 16 November 2015 – the previous morning. (Linton, 2019.) In light of the other photographs available this seems correct.*		
0615	However the Coroner's Report contains another photograph showing very low fire activity, also dated for Tuesday morning. "This photo taken by Mr Carmody as he flew over on Tuesday, 17 November 2015 in the morning" (Linton 2019:24.) This photograph is almost certainly from the same flight as that above. So it is possible the fire was very low at this time.		
0900			24.3C 49% hum 16.6 km/h SE
0700-1000	• The New Chaining Crew continued to work on PLAN B and expanded the existing firebreak along the boundary of the UCL and the northern end of Neds Corner Road by chaining. • A private loader and tractor, using a private chain, were being operated by local farmers/ volunteers (Private Chaining Crew) to assist in the installation of PLAN B. • The Tracking Crew continued implementing REVISED PLAN A and tracking the fire edge near Lake Mends. • The Harvest & Plough Crew continued to use available machinery to implement PLAN C.		
0800	Volunteers started to arrive at the check in point in personal Light Units and a number of the local BFBs' Heavy Units. At the check in point, volunteers were checked onto the Fire Ground.		
0830	The Commanding Fire Control Officer received a weather forecast. Forecasted conditions that day were for average wind speeds of 35km/hr with gusts of up to 60km/hr. The worst conditions were forecasted for 15:00.		
1000	Winds picked up significantly at the fire.		
1030	The Tracking Crew contacted the ICV using a bush fire radio and advised them that the wind where they were had picked up significantly.		
1036	A picture of the Fire taken from Neds Corner Farm that illustrates the extent of the ploughed break installed by local farmers/ volunteers on boundary farmland and as part of PLAN C. (Pacer Legal 2016:26).		

1048	MODIS Terra Satellite Pass shows fire extent.		
1100-1200	The Tracking Crew was amongst the lakes in the Lake Mends area when the wind picked up. Bulldozer A was used to clear a pad and the personnel and machines were thereafter parked on the pad for safety.		
1130 – 1230	The CFCO assessed the situation from the air in a helicopter. The Commanding Fire Control Officer observed that there were flames everywhere, the flames were 40–50m high and the fire front was approximately 6km in length. The smoke was extremely thick and black. The Fire was estimated to be making jumps of about 400m at a time. The CFCO contacted the ICV and updated personnel of the conditions. The Commanding Fire Control Officer ordered immediate evacuation of the ICV and staff to the first prearranged fall-back point, being ICV Fall Back Position 1. The Commanding Fire Control Officer could see the Tracking Crew amongst the lakes. The personnel in the helicopter contacted one of the Heavy Units that formed part of the Tracking Crew with a VHF radio. The Tracking Crew was advised to stay stationary for safety, and after the fire front had passed, they were instructed to continue tracking the burnt edges of the Fire. The Commanding Fire Control Officer could see the Private Chaining Crew and the New Chaining Crew. The Commanding Fire Control Officer contacted both crews from the helicopter and instructed them to stop chaining and to retreat.		
1150	Fire was approaching Ned's Corner Farm The picture of the Fire taken from the Neds Corner Farm illustrates the approaching fire. (Pacer Legal 2016:27).		
1156	Fire jumps from UCL to Farmland. The photograph of the Fire taken from the Neds Corner Farm illustrating the Fire jumping the chained break on Neds Corner Road onto farmland. (Pacer Legal 2016:28).		
1200	Local farmers and volunteers situated on the boundary of the farmland and the UCL made calls on the UHF radio to the ICV to advise them to evacuate but they were unable to make contact. Local farmers and volunteers also tried to contact the helicopter flying overhead via UHF radio but were unable to make contact. Local farmers and volunteers commenced evacuating themselves, their families and their neighbours.		36.9C 16% hum 29.5 km/h NNW

1200-1400	Member for Eyre, Dr Graham Jacobs (Member for Eyre) personally approached the Minister for Emergency Services (Minister) requesting water bombers. He is informed that as the fire is not a level 3 "we won't mobilise water bombers, and anyway, we don't have any available". *[Note that this is not correct – water bombers are available for ALL fire levels – Greg Mair, DBCA Regional Manager].*	
1211	 A picture of the Fire taken from the helicopter. (Pacer Legal 2016:29).	
1230	The Commanding Fire Control Officer observed that ICV Fall Back Position 1 was under threat. The Commanding Fire Control Officer was dropped off by the helicopter at the ICV, which was located at ICV Fall Back Position 1. The helicopter left the Fire Ground. The Commanding Fire Control Officer had no aerial support from this time onwards on Tuesday.	
1230	65 volunteers from various local BFBs had by this time checked onto the Fire Ground. These volunteers were on the Fire Ground in addition to the New Chaining Crew, the Private Chaining Crew, the Harvest & Plough Crew, the Tracking Crew, the ICV Team and all the local families that reside in the area. There were approximately 20 vehicles at the ICV that also needed drivers to relocate them.	
1230	After discussion between DFES and Local Government, a formal Section 13 Request by the Shire CEO, and an Assistant Commissioner of DFES appointed a DFES Area Officer as the authorised person to take control of all operations.	
1235	BOM issued a Severe Weather Warning forecasting "damaging winds" for the Goldfields District that day. The Weather Warning that a strong north-westerly flow was likely to cause DAMAGING WINDS of up to 100km/hr until 18:00 that evening and that winds may make road conditions hazardous.	
1244	BOM Issued another Spot Fire Weather Forecast for "Lake Mends": Spot Fire Weather Forecast 3 predicted possible north-westerly wind gusts up to 90km/hr until 17:00. The predicted GFDI maximum was revised from 110 to 233.	
1245	CFCO instructed all volunteers via channel 5 of the UHF radio to evacuate.	
1245	The Commanding Fire Control Officer stood on the road and instructed volunteers that were then at the ICV to drive no faster than 50km/hr and to retreat away from the fire front towards the Second Prearranged 'Fall Back Point' in convoy.	
1130-1430	At this time conditions were extreme. Thick smoke, dust and dirt were being blown around by heavy winds resulting in very low visibility. Flames from the fire front were igniting new fires ahead. The Fire was easily jumping all containment lines that had been installed. Communication had become difficult.	
1300	A weather reading taken at Vege Patch recorded wind speeds of 101km/hr, a temperature of 43°C and humidity of 0.2%.	In CFCO's experience, he had never seen conditions like this with a fire raging, and after the fact he came to understand that they were the most extreme fire conditions recorded in Australia to this date.He described it as an "absolute disaster. Linton 2019:31.	37.9C 17% hum 27.7 km/h NW
1310	"Need water bombers!!!" is recorded on Log of Radio Fire Response by Communication base at DFES office. (Pacer Legal 2016).	

1333	 A picture of the Fire taken on Rollond Road illustrating visibility. (Pacer Legal 2016:32).		
1339	Updated progressive extent Map		
1300-1400	The ICV and its convoy of vehicles arrived at the second prearranged fall back point, being ICV Fall Back Position 2. The ICV and its convoy were trying to get to the third prearranged fall back point (ICV Actual Location 2). The Commanding Fire Control Officer sent various Light Units to determine which roads could be travelled upon by the ICV and its convoy. By this time, many of the roads in the area had flames on both sides as the nature strips were alight. Ultimately, the ICV and its convoy were rerouted east to the intersection of Belgian Road and Rollond Road, south along Belgian Road and then in a westerly direction along Grass Patch Road to the ICV Actual Location 2.The ICV was then re-established at this location. During this period, the Commanding Fire Control Officer also directed various Light Units to check on homesteads and to ensure that all residents along the way were evacuated.		
1300-1600	After the Fire had passed them, the Tracking Crew continued to track the edge of the Fire in the Lake Mends area.		
1400-1900	After the Fire passed over, volunteers worked in teams to control spot fires created as the fire front had passed through. Vehicles, homes, field bins, machinery and sheds were all monitored and where possible, saved from fire.		
1400			38.5C 5% hum 38.9 km/h NNW
1444	DPaW Regional Situation Report Incident 3 Report 3 identifies the “Lake Mends/ Cascade Fire” as one of six incidents, and is listed, along with three of the other incidents, as the third priority (“Incident 3”) categorises the incident as a Level 1 incident and notes that there are no DPaW staff assisting Local Government on the Fire.		
1500			40.7C 2% hum 44.3 km/h WNW
1530	The Fire was upgraded to a Level 2 incident. Wind gusts of up to 93km/hr were recorded at Salmon Gums.		
1600 /1700	BOM issued another Severe Weather Warning reaffirming the predicted “damaging winds” for people		40.1C

	near Esperance. Severe Weather Warning 3 detailed the current weather situation as "a strong north-westerly flow is causing DAMAGING WINDS to 100 km/h with conditions expected to ease by 18:00 this evening. DUST STORMS are also possible and thunderstorms are occurring over eastern parts of area. Conditions will ease from the west during the remainder part of the afternoon".	2% hum 46.4 km/h WNW
1600-2200	An evacuation centre was set up at Salmon Gums Primary School. People were evacuating to the School following reports broadcast on the ABC radio. By 17:00, it was reported that there were at least 150 people and a large number of cars, caravans, campers and floats on the oval at the School.	
1617	A view of the Fire taken from northwest of Grigg Road, showing the Fire front approximately 1 km away, in north westerly direction and travelling in south easterly direction towards Grigg Road. (Pacer Legal 2016:35). 	
1620	The CFCO instructed the Tracking Crew to track back out of the lake area the same way they went in, and thereafter track the boundary of the UCL and the farmland from Pyramid Farms in an easterly direction towards Salmon Gums.	
1640	**The fire front crossed Griggs Road, resulting in four fatalities.**	
1640	Based on when the fire front crossed Griggs Rd, this map indicates the likely extent at this time. The front has travelled approximately 50 km in three hours. 	
1641	The Commanding Fire Control Officer received reports that the Scaddan townsite was under threat. The Commanding Fire Control Officer instructed units and volunteers dispatched from Scaddan to return to Scaddan to manage the incident in the area that they were most familiar with. A text message was sent by the Shire of Esperance stating: Please note the Cascade fire is threatening Scaddan townsite. If you are leaving you need to leave now. If you are staying you will need to defend. From SHIRE OF ESPERANCE, To opt out reply stop.	
1700		38C 6% hum 38.9 km/h WNW
1746	DFES issued an alert: Bushfire Emergency Warning issued for people north of Fleming Grove Road, Plowmans Road, west of Blackmans Road and Burdett Road, south of Salmon Gums Road and west of Coolgardie-Norseman Highway in North Cascade in the Shire of Esperance. Fire is heading towards Dempster Road. People in Scaddan have been asked to relocate north to Salmon Gums recreation centre.	
1800	The wind changed direction from northwest to southwest, and was still very strong.	26.6C 42% hum 38.9 km/h WSW
1800	The Commanding Fire Control Officer received reports that the Salmon Gums townsite was under threat.	
1905	The Member for Eyre telephoned the Minister for Emergency Services, in relation to the Fire.	
1912	BOM issued another Severe Weather Warning - cancelled the Severe Weather Warning for people near Esperance and advised that "although gusty winds are still possible, the threat of damaging winds is no longer expected".	
1915 - 1935	The Member for Eyre sent six text messages to the Minister, others to Principal Policy Advisor and Chief of staff of the Minister.	

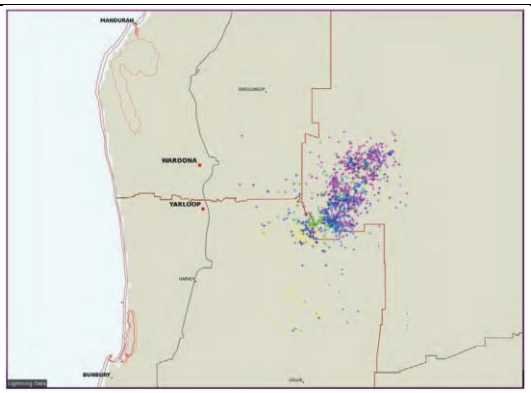
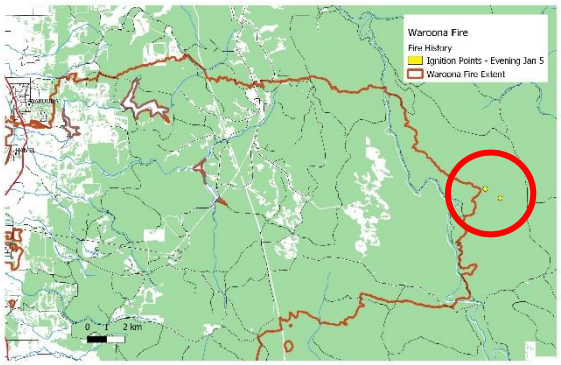
1920	The Cascades Fire was upgraded to a Level 3 incident		
2100	With a light westerly breeze and cooler, damp conditions, the ability to fight the Fire improved.		
2200-2300	A DFES Officer attended the ICV. This was the first time that anyone from DFES had come to see the Commanding Fire Control Officer at the Fire Ground. The DFES Officer requested a briefing. The Commanding Fire Control Officer provided the DFES Officer with a briefing. The DFES Officer confirmed that DFES would 'fly the area' and identify hot spots using infra-red technology and thereafter provide the Commanding Fire Control Officer with maps indicating these points by 08:00 the next morning. The Commanding Fire Control Officer did not receive these maps until about a week later.		
2300	The Commanding Fire Control Officer instructed various crews to stand down and return to the Fire Ground in the morning.		

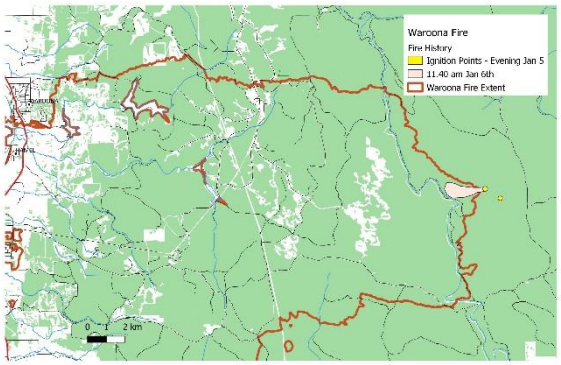
Wednesday 18 November 2015			
0630	An Aerial Fire Suppression Request Form was faxed (Aerial Request Form). The Aerial Request Form indicates that the request was made by DFES and that the Controlling Agency at this time was DFES and Local Government. The Request Form requests "4 Fixed Wing Aircraft to Esperance Airport for Deployment as required to Esperance Fires".		
0700-0800	The Commanding Fire Control Officer assessed the situation from the air in a private aircraft with the Captain of the Munglinup BFB.		
0800	A briefing was held at the ICV. Approximately 150 people were in attendance. No DFES personnel were in attendance.		
0830	Volunteers received notice via UHF radio that the fires that had started the previous day around Roberts Swamp, had flared up. By 08:35, there were multiple Heavy and Light Units in attendance at the Roberts Swamp fire. The Commanding Fire Control Officer received information from the teams that they were done with their previously allocated tasks. The Commanding Fire Control Officer then tasked these teams to assist at Roberts Swamp.		
1444	DPaW Regional Situation Report created (Situation Report 4). The "Lake Mends/ Cascade Fire" is one of nine incidents referred to, and is listed, along with the other incidents' in the Esperance District, as the third priority ("Incident 3"). Situation Report 4 notes that the fire is being managed by Local Government/DFES however in the document specifically relating to "Incident 3" the Controlling Agency is referred to as Local Government. The Incident 3 Report 4 identifies the incident as a Level 1 incident (!).		

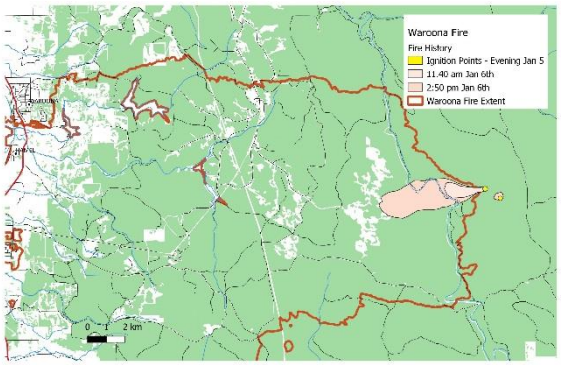
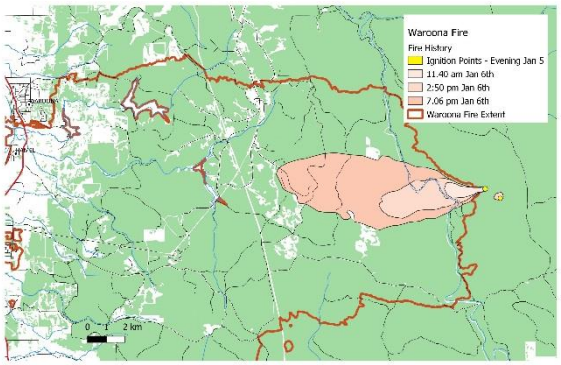
Thursday 19 November 2015			
1000	Approximately 50 people were at the ICV. DFES personnel had arrived by this time. Volunteers reported witnessing heated discussions between DFES personnel and volunteers regarding the hierarchy between the units, now that DFES had arrived.		

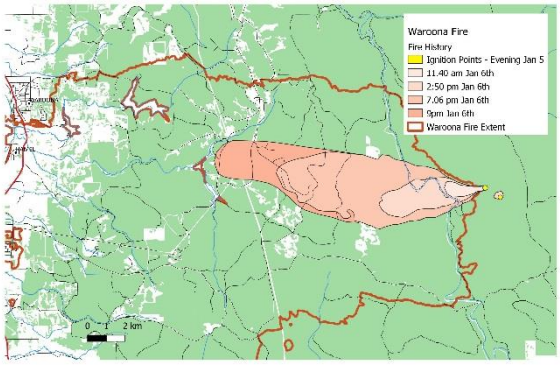
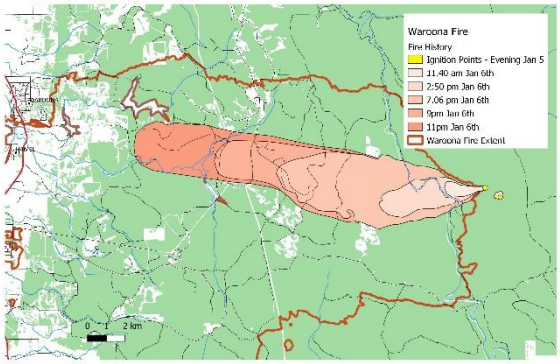
Waroona Bushfire (Fire 68) – Wednesday January 6th 2016

This timeline is largely extracted from Appendix 7 of the Special Inquiry into the Waroona Bushfire (the Ferguson Inquiry). The fire Progression maps are extracted from McCaw et. al. (2016).

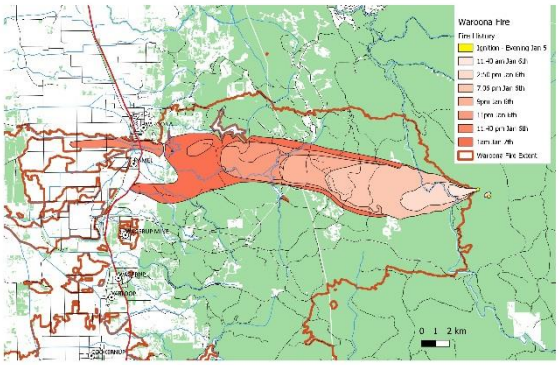
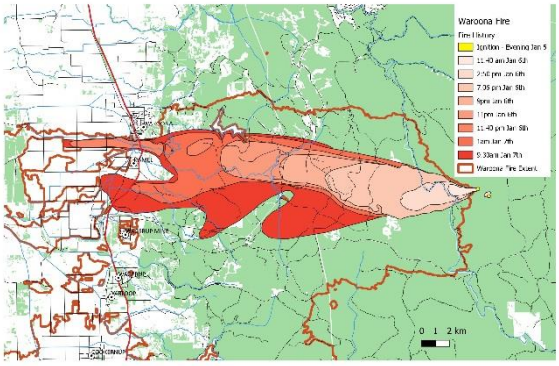
Time	Description	Map	Weather
			DWELLING UP weather – 30 km NNW of Yarloop
Tuesday January 5th 2016			
Evening	Significant thunderstorms were noted in the Dwellingup area. The large number of strikes is shown in this figure, BOM 2016:27 (Appendix 6 in the Waroona Special Inquiry Report Vol 2.) It shows lightning during the period 1900 to 2000 AWST 5 January 2016.		
Evening	Lightning activity during 5 January 2016 ignites two fires west of Murray Road in a young forest block. The two fires (circled) are titled Fire PH68 (Fire 68 – the Waroona Fire) and Fire PH69 (Fire 69).		Midnight 20.5C 69% hum 0 km/h Calm
Wednesday January 6th 2016			
0039	First satellite trace of fire (Fire 69) registers on satellite. (VIIRS/Suomi NPP 375m satellite). At the time of the satellite pass the fire is very small – likely less than 5ha in size.	The satellite trace of Fire 69 is a couple of pixels in size (17ha), and can be seen in the map below, 1km to the east of the initial location of Fire 68. No trace for fire 68 at this stage: 	21.7C 63% hum 27.7 km/h ESE
0600	Residents preparing to leave for work in Waroona reported a smell of smoke.		

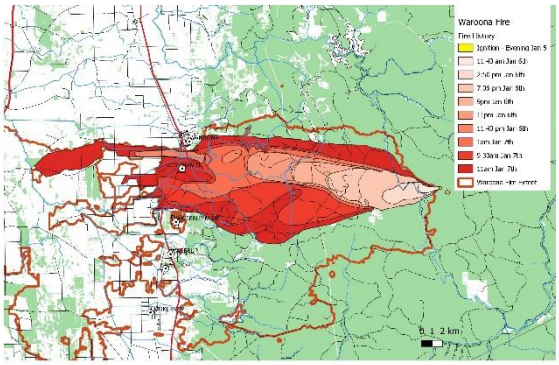
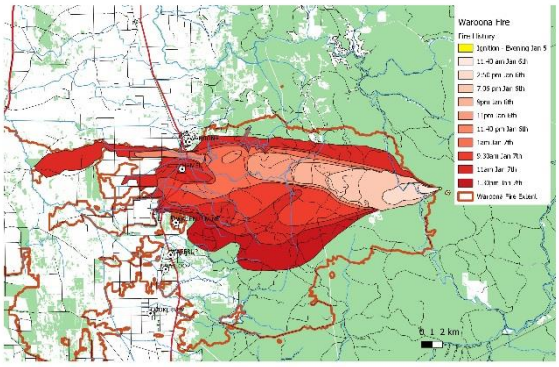
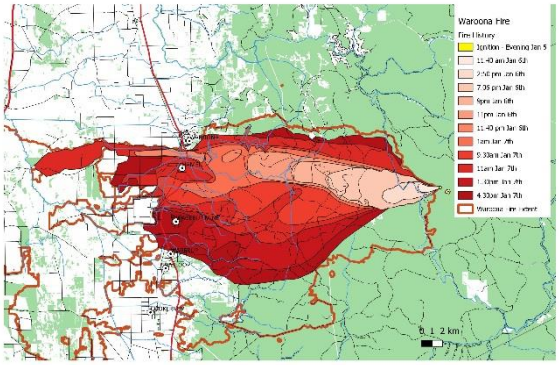
0630	Both fires were first detected by P&W staff monitoring the Landgate 'FireWatch' website at 0630 hours on 6 January 2016		
0645	First response from Dwellingup. Decision to ground attack only Fire 69 due to safety concerns on Fire 68.		
0700	P&W spotter plane was deployed.		20.3C 70% hum 25.9 km/h ESE
0725	Spotter plane confirmed the presence of two fires near Nanga Road, Dwellingup. Fires about 1km apart. The fires were 3ha and 6ha in size. [The Special Inquiry report does not say which fire was which size, but it seem reasonable to assume from the satellite trace above – which only shows Fire 69 - that Fire 68 was the smaller fire.		
0703	Following the initial detection of the fire, the P&W Duty Officer requested the following P&W crew to be dispatched from the P&W Dwellingup depot: • four four-wheel-drive heavy fire vehicles and • one front end loader. A P&W Field Operations Officer was dispatched from Dwellingup.		
0720-0730	P&W machinery was mobilised, with trucks and a front end loader despatched from Dwellingup. The initial P&W crews were tasked to first work on the easternmost (Fire 69). This was due to the direction in which Fire 69 was moving. The presence of easterly winds made Fire 69 a threat to the safety of crews who may be deployed to fight the westerly Fire 68. Access to Fire 68 was also hampered by large rocky outcrops and the presence of a large number of dead trees. **Fire 68 became the main fire front known as the Waroona fire.**		
0726	Four fixed wing water bombers were requested by the P&W duty officer.		
0745	Two water bombers each were dispatched from both Jandakot and Bunbury (making four in total). The aircraft were instructed to focus their suppression activities on Fire 68, with the aim of holding it until ground crews could gain access.		
0800	An IMT was established at the P&W Mundaring office to manage the Department's response to the fire. The P&W Duty Officer became the IC. Shortly after establishment, the IMT informed the DFES Communications Centre of the fire.		
0815	Spotter aircraft reported the fire (68) was 8 hectares in size. Fire Rate of Spread was 50-100 metres per hour.		
0830	**Fire declared a Level 1 incident by P&W IMT.** At the time of declaration as a Level 1 incident, it was anticipated by the IMT that the fire would be brought under control with relative ease.		
0830	By approximately 0830 hours, the total P&W resources deployed to the fire included four trucks from Dwellingup and four trucks from Jarrahdale, each manned by two people; two dozers; and two front end loaders.		
0845	Helitaks requested by P&W to help fight the fire.		
0900			25.3C 50% hum 20.5 km/h E
0930	The first IAP prepared and approved by P&W. The objectives were to contain both fires to the east of the Murray River and west of Murray Rd. The strategies to be employed to achieve containment were direct attack on the fire using dozers and front end loaders, with support by aircraft and ground crews.		
0942	Aircrane requested by P&W to assist in fighting the fire.		
1000	The resources deployed by P&W had increased to seven experienced officers, eight trucks, two front end loaders, two dozers and three water carts. Two additional trucks were on their way from Boddington. The IC reported to the Special Inquiry that he and his team were comfortable with this level of deployment; particularly given experienced operators were working on the fire.		
1130	Fire 68 jumps over Murray River. (This is according to the timeline in Ferguson (2016) V2).		
1143	Fire 69 is contained. Containment was achieved through ground based direct attack.		
	Significant access issues remained for crews attempting to fight Fire 68:	"… because of the location and the terrain, we were having great difficulty in establishing – or rapidly establishing – mineral earth breaks … it was right on the breakaway into the Murray Valley. There was also a creek line to the south of it … So although we had machinery quite quickly on site … the initial tracking was difficult." (Ferguson (2016) V1:72)	
1150	The reconstructed rate of spread of fire 68 is between 1140 hours and 1450 hours was 1,105 metres per hour. Mapping reconstruction suggests area of 109 ha. Map extent for 11:40 am shows the leading edge of the fire just short of the Murray River.		

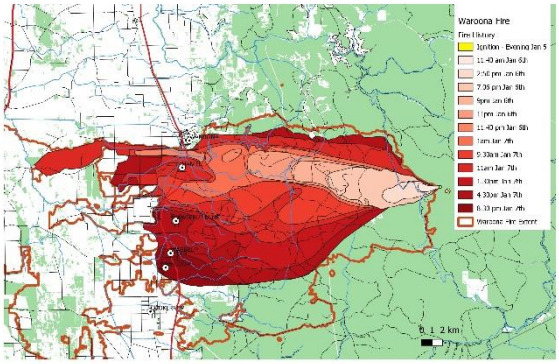
1200	Fire 68 800m east of Murray River.		32.8C 28% hum 14.8 km/h ENE
1330	Fire grown to 160 ha, the closure of Nanga Rd ahead of the fire was authorised by the IC.		
1345	Fire 68 jumps over Murray River. ("It was when the fire jumped the Murray River shortly after this time (1330) that a marked escalation of the response occurred." ((Ferguson (2016) V1:67). It continued to gather momentum and increase in size. After this time a marked escalation of the response occurred.	At the time the fire crossed the Murray River there were a number of cues that the fire was likely to develop into a significant (and therefore a Level 3) fire: • the head fire was unable to be controlled; • forest fuels were drier than average; • access was hampered by steep rocky terrain; • the fire was burning into State Forest where bauxite mining operations hampered • access and suppression; and • a pyro-cumulonimbus cloud had formed over the fire. (Vol 1, p70)	
1405	A further Advice alert for the Lane Poole Reserve was issued.		
1450	Map extent for 2.50 pm shows the leading edge of the fire well past the Murray River.		35C 18% hum 13 km/h NE
1530	**The IC makes the decision to elevate the incident from Level 1 to Level 2.** Planning commences for the P&W pre-formed Red IMT activated and readied for a shift changeover at 0600 on 7 January. Fire burning through the Alcoa rehabilitation forest. CBFCO Waroona raises concern at area covered by warnings and rings property owners in path of fire and warns them to prepare / leave.		
1625	2 FW (fixed wing water) bombers dispatched from Manjimup.		
1700	Fire plotted as 800ha, moving at 1 to 1.5km/h. Fire approximately 2200 hectares in size. At this time there was an 'unexpected and dramatic' escalation as fire crossed Nanga Road. (Ferguson (2016) V1:70)		35.2C 26% hum 13 km/h W
1730	A large pyro-cumulonimbus cloud had formed above the fire, and the plume was moving towards the south-west. This thunder cloud formation brought additional risks of strong erratic updraft and downdraft winds which result in unpredictable fire behaviour.		
1900	Fire 2800 ha in size with a forward rate of spread of 1.5-2km/hr. Pyrocumulonimbus (PyroCB) activity with lightening was widely observed. The fire was 13km from Waroona. At this time, the IMT "had predicted that there was an estimated 12 hours before the fire reached the Waroona townsite…. However, shortly after 2100 hours the Waroona townsite was reported to be under sustained ember attack." (Ferguson (2016) V1:72)		33C 30% hum 3.6 km/h N
	Reconstruction of the fire suggests that between 1800 and 1906 hours the rate of spread of the fire increased to 3272 metres per hour. This period coincided with the fire encountering an area of un-mined forest in a proposed national park: this area was last burnt in 1978 and contained fuel with an age of 37 years.		

2100	The first Watch and Act alert was issued for the Lane Poole Reserve and the Alcoa mine site and adjoining private properties, but not including the Waroona township.		28.9C 36% hum 29.5 km/h ESE
2110	Waroona is reported to be under sustained ember attacks coming from the fire.		
2115	The Harvey CBFCO received a call from the DFES Communications Centre advising that there was fire in Waroona. Evidence of a number of independent ignition points a distance from the main fire – this included in areas to the east of Waroona. The spot fires were approximately 13 kilometres away from the last known location of the head fire. From the IMT's point of view, the fire had shifted 13 kilometres in an hour and a half. This rendered the fire behaviour predictions to date and the IMT's predetermined strategy redundant.		
	At the time the spot fires around Waroona broke out, all the P&W resources were located on the east side of the Murray River and were not readily deployable to Waroona, which is located to the west of the river.		
2136	Fire was well across the South Western Hwy and heading west through farmland.		
2200	Decision taken to issue an Emergency Alert (EA) telephone message. Attempted telephone alert unsuccessful due to technical issues.		26.8C 40% hum 27.7 km/h ESE
2215	IMT requested additional resources from the local government and DFES for deployment into Waroona for asset protection. The requested resources were drawn from the Waroona Volunteer Fire and Rescue Service and Yarloop and Cookernup Bush Fire Brigades.		
2215	**Formal escalation of event from Level 2 to Level 3 complete**		
2225	Emergency warning issued by P&W for Waroona townsite, Alcoa mine site and adjacent properties in Shire of Waroona.		
2227	DFES released Emergency Warning for the Waroona townsite, Alcoa minesite and adjacent private properties in Shire of Waroona.		
2259	Waroona Controller informed from SCC that water pumping station was critically damaged and required attention.		
2300	A further EW was issued for Waroona and Hamel.		25C 45% hum 29.5 km/h ESE
2325	Issues reported with Telstra system in sending out messages. P&W Officer reported that main fire was within approximately 1km of Waroona townsite and a second (spot) fire had crossed Fawcett Rd to the west of Waroona. Local Bushfire Brigades were operating around Waroona and Hamel and to the west.		
2335	The fire is reported by P&W to be 1km of the Waroona townsite.		
0000	The fire had covered 35kms and reached 12,000ha in area.		23.5C 50% hum 25.9 km/h ESE

Thursday January 7th 2016		
0015	Emergency Warning issued for western edge of Waroona townsite in the Shire of Waroona. This includes the Waroona and Hamel townsites.	
0022	22 trucks on site to respond to fire south of Waroona. Wind gusts 80km/h, fire 3m high.	
0035	Emergency Warning issued for Waroona townsite, Alcoa mine site and adjacent private properties in Shire of Waroona.	

0100	Fire impacts Hamel		22.3C 53% hum 24.1 km/h ESE
0105	Emergency Warning issued for Waroona town site, Alcoa mine site and adjacent private properties in Shire of Waroona.		
0254	16 trucks depart Narrogin to assist.		
0300	Emergency Warning issued for Waroona and surrounding areas, including Preston Beach, in Shire of Waroona.		20.9C 57% hum 24.1 km/h ESE
0309	Power is reported as lost at Waroona. Water Corporation reports water ok.		
0400	Resources as of this time: DFES resources: 40 appliance and 100 personnel P&W: IMT 75 people transitioning including 30 trucks, 30 light units and 12 loaders.		
0445	Properties under threat in Waroona.		
0500	Fire reported as being 5km from Forrest Hwy. Fire bombers begin to water bomb south flank of fire east of Coronation St.		20.7C 56% hum 22.3 km/h ESE
0726	Power and communications control telemetry to the Yarloop Town Water System lost. “This meant that water supplied to Yarloop was gravity fed, which would result in reduced water pressure for the end user”. (Ferguson (2016) V1:76)		
0736	SOC briefing was told that up to 90 per cent of the fire was untracked and that there was no expectation the fire would be held on that day.		
0755	Emergency warning received that Preston Beach needs evacuation		
0757	Waroona reported as about to run out of water.		
0800	Main fire coming into Hamel. Total fire ban request rejected.		25.7C 41% hum 20.5 km/h E
0809	30 people evacuated from Preston Beach by boat. 1 shed reported as damaged Preston Beach.		
0917	Waroona reported as about to run out of water.		28.5C 33% hum 24.1 km/h E
0930			
1028	Wagerup reported as under threat.		

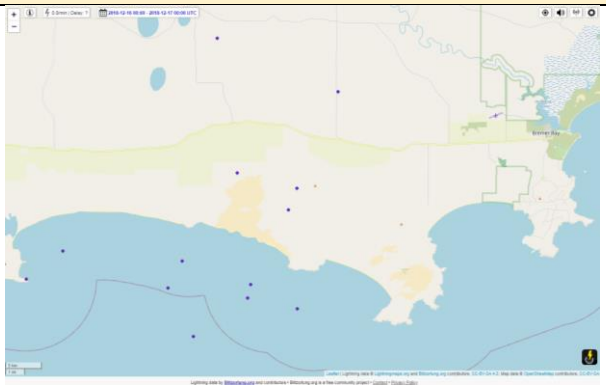
1100			33.8C 22% hum 16.6 km/h ENE
1105	Fire and rescue crews are dispatched to Yarloop to help fight the oncoming fire		
1210	Emergency Warning issued for Waroona and Harvey and surrounding areas.		35.6C 18% hum 25.9 km/h E
1234	Lightning observed in the fire area.		
1254	Yarloop reported as contained.		
1330			
1400			39C 13% hum 18.4 km/h ENE
1450	Resources committed as of this time: DFES- 40 appliances, 100 fire fighters, CLT, USAR RDAT. P&W- approximately 75 personnel, 30 trucks, 30 light units, 23 earthmoving machines.		
1500	Fire was reported as being three kilometres north and five kilometres east of Yarloop v1		38.5C 13% hum 13 km/h NNE
1556	Main Road notes that CMT 2pm meeting advised fire heading south – Yarloop and Harvey under threat.		39.5C 11% hum 14.8 km/h E
1630	The fire was reported to be one to two kilometres both north and east of Yarloop.		

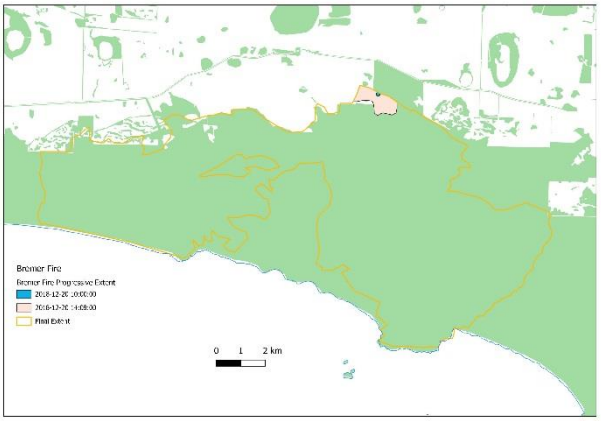
1700	Water Corporation advised the IMT of its intention to tank water into Yarloop. Western Power reports 3500 people without power. Water Corporation reports no water in Yarloop or Preston Beach.	39C 11% hum 18.4 km/h ENE
1830	The Harvey Chief Bush Fire Control Officer communicated with the DFES Incident Control Vehicle in Waroona a request for extra firefighting units for asset protection. The resource request was discussed, but was not fulfilled. The Special Inquiry assessed that the Harvey CBFCO's position and the significance of his request was not recognised by the Division Commander or the IMT Operations structure. Therefore there was a delay in recognising, and in providing the additional firefighting resources that were requested by the Harvey CBFCO for the protection of Yarloop.	
1916	Fire crossed the South Western Hwy and entered Yarloop.	
1920	Localised very strong wind event in the Yarloop area. Fire behaviour rapidly escalated, triggered by the sudden arrival of a strong easterly wind estimated at around 80km/hr. Yarloop township reported seriously impacted by fire.	
1900	Sometime between 1900 hours and 2000 hours on Thursday 7 January 2016 a strong easterly wind event affected the fire ground. This was particularly felt at Yarloop.	34.9C 13% hum 22.3 km/h ESE
1930	The extreme fire behaviour caused massive spotting and ember attack which resulted in the ignition of many buildings in Yarloop within a very short period of time. Many houses ignited simultaneously, overwhelming the firefighters and small number of residents who remained. Tragically, two residents lost their lives when they were sheltering in their homes.	
2000		32.8C 14% hum 22.3 km/h E
2030		
2010	Yarloop fire station, railway museum, shops and houses destroyed.	
2029	Lake Preston is reported as coming under attack from the fire.	
2050	A Fire Strike Team manages to enter Yarloop and begins to assess what structures can be defended from the fire with minimal water.	
2100	An Emergency Situation Declaration is issued under the Emergency Management Act 2005.	31.8C 14% hum 22.3 km/h E
2121	Yarloop Hotel was reported to be on fire followed by the hospital, fire station and multiple houses. A message to DFES is received stating that an estimated 200 people at Preston Beach require evacuation.	
2129	71 people reported as staying on Yarloop oval.	
2142	Yarloop fully impacted by the fire. At this time the fire station and police station are on fire.	
2200		31.1C 15% hum 14.8 km/h ENE
0000	Throughout the night the Strike Team and Volunteers extinguish fires around Yarloop properties, door knocked residents, responded to 000 calls and respond to reported injuries and missing persons. Fire crews are unable to relieve and assist the Strike Team and Volunteers during the night given the hazardous conditions. 70-80 people gathered at town recreation centre and were advised to make their way to the recreation ground.	28.7C 20% hum 20.5 km/h ESE

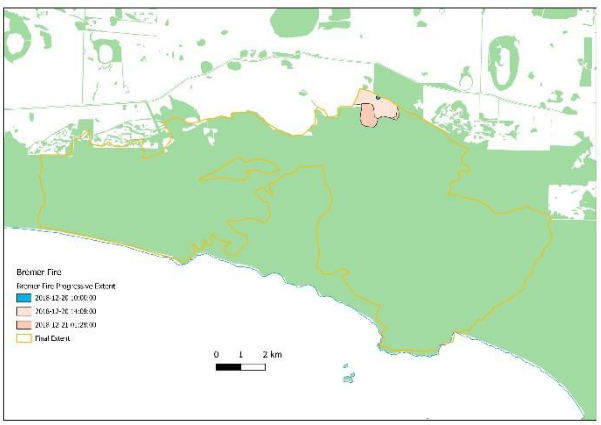
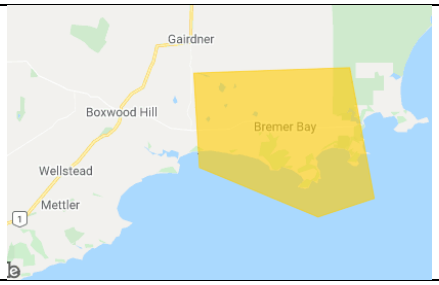
Post Fire.	Aerial view of Yarloop in Feb 2016. (Google Earth Pro).		
Friday January 8th 2016			
0210	Fire has now cut off Preston Beach.		
0750	Harvey ordered to evacuate.		
0900			27.1C 33% hum 13 km/h ESE
0933	Lightning strikes observed to the west of Waroona. Information requested for a safe route out of Preston Beach. Harvey reported as under threat from fire.		
1140	Evacuation of Yarloop approved.		23.5C 56% hum 14.8 km/h ENE
1407	Fire reported as having progressed into Cookernup.		
1600	Metro reports it cannot provide any more resources due to lightning strikes in Perth Hills.		28.2C 39% hum 13 km/h E
2245	Fire is reported as 5km out of Harvey.		
2325	Emergency warning issued for Harvey.		
0130	Fire moving towards Harvey at a slower rate		

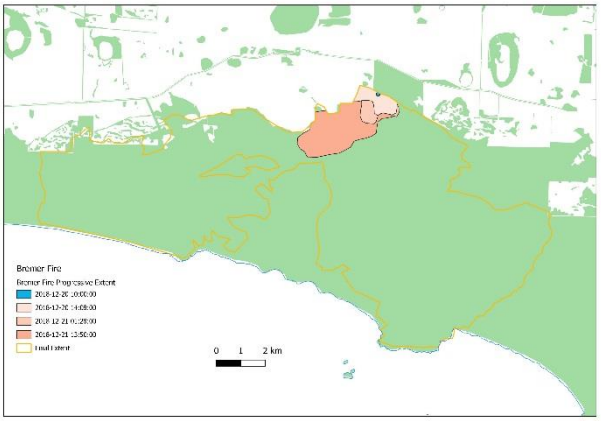
Bremer Bay Fire – December 20 2018

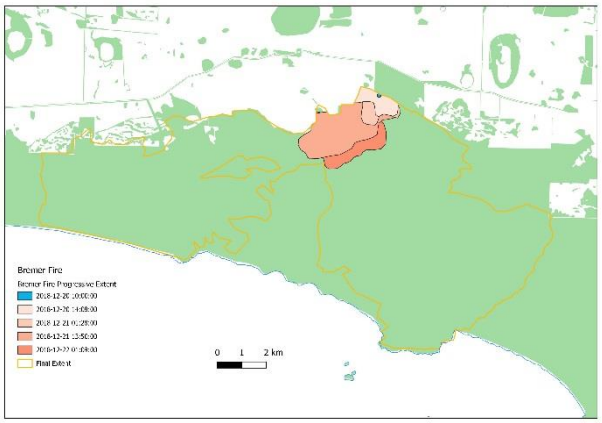
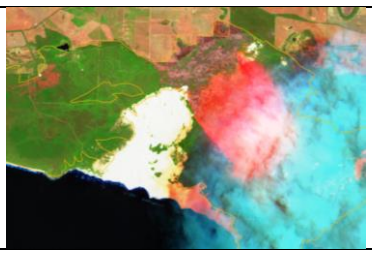
Fire extents shown in this timeline are indicative: they are taken from different satellite sources, and with low resolution data (VIIRS/Suomi NPP 375m satellite or MODIS Aqua & Terra Satellite) in most cases. Not all fire extent may be mapped due to the time fires grew and the satellite passes.

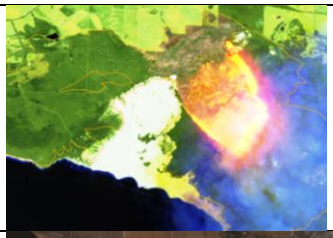
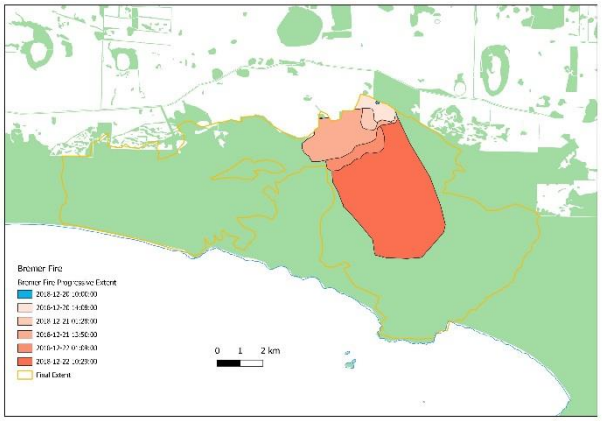
Time	Description	Map	Weather
			JACUP 60km NNE
Sunday December 16th 2018			
0800-2400	Lightning strikes recorded in the region. "I recall asking them how it got so big and observing that the lightning went through five days before and the fire wasn't seen for that long. " N McQuoid, pers. com, in discussion with Peter Hartley the DBCA District Manager, Dave Edwards Jerramungup Shire CBFCO, after the fire. The recorded strikes are not exactly where the fire started, but indicate there was lightning about at that time. Nephew of Anthony Thomas recalls hearing the strike that likely started the fire. Nothing was done about these until the fire emerged 5 days later.		
	There was heavy cloud cover on the 16th/17th/18th, with cloud only clearing by the 19th.		
Thursday December 20th 2018			
1000			20.1C 45% hum 14.8 km/h E
1123	The fire was first reported. It started near the intersection of Borden-Bremer Bay Road and Warramurrup Road in Bremer Bay.		22.4C 38% hum 18.4 km/h E
Midday	Numerous resources on site – including 4 heavy units and a number of farm units, spotter plane.		
	Shire grader as on site.		
1230-1300	The active fire was about 1km into UCL. Small bulldozer was unable to make progress in getting to the active fire front, as the terrain was hilly and sandy country.		
	There were delays getting dozer of sufficient size (or the 'right style') to cut breaks. By the time this was done the fire was getting away.		
	"Bombers might have suppressed the fire enough to get to it on the first day, but it was always going to be hard." Anthony Thomas.		

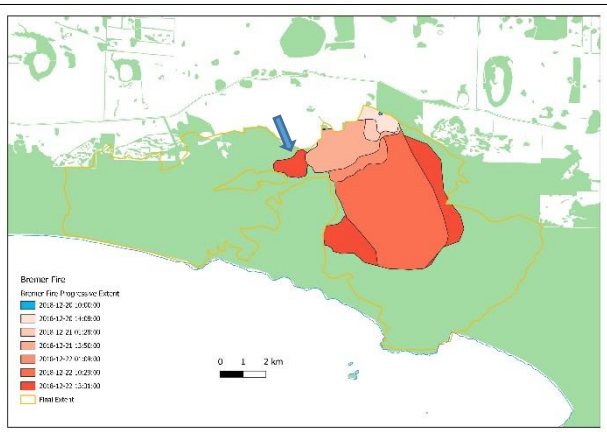
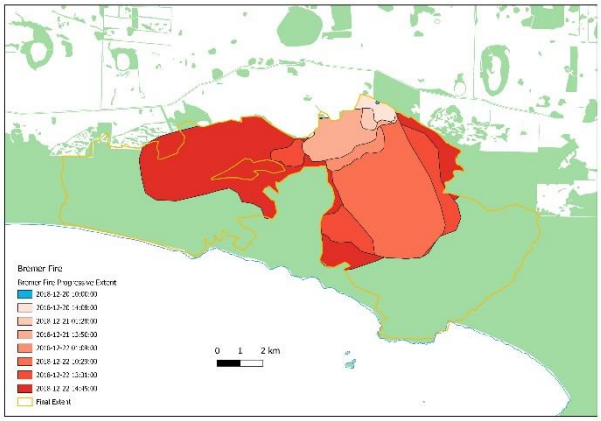
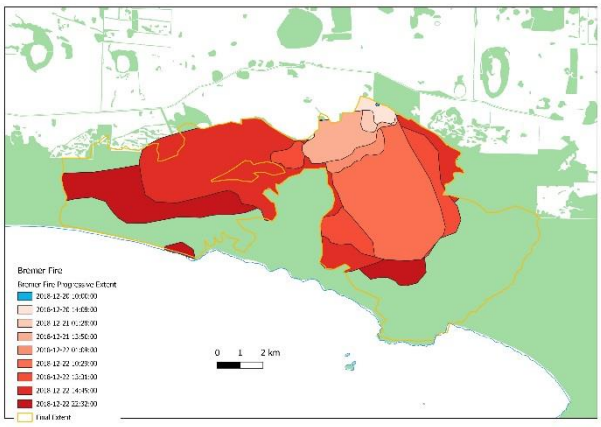
1408	Fire has grown to approx. 100ha.		22.7C 33% hum 24.1 km/h SE
Later in the day	Bulldozer arrived.		
	According to Anthony Thomas, water bombers were called for on day 1, but were not available.		

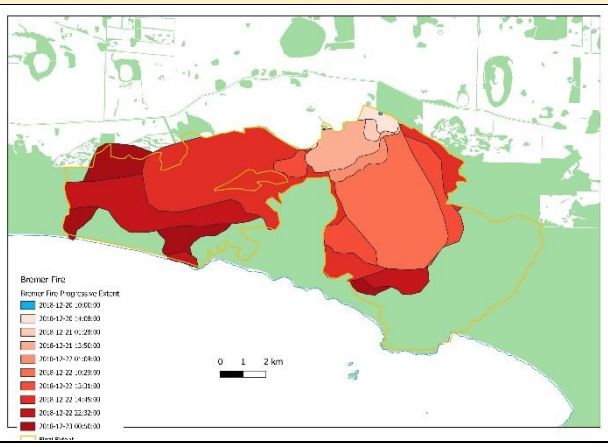
Friday December 21st 2018			
0128	Fire has grown slowly to approx. 170ha.		12.2C 91% hum 13 km/h E
AM	Water bombers were deployed according to Anthony Thomas (time unsure)		
0900			19.1C 49% hum 16.6 km/h ENE
1120	DFES release Bushfire WATCH AND ACT for western part of BREMER BAY and the eastern part of BOXWOOD HILL in the SHIRE OF JERRAMUNGUP.		
1120	DFES: "Currently there has been 200 hectares burnt."		
1211	More than 60 firefighters are battling the blaze are on the scene and water bombers have been sent to help ground crews.		26.1C 22% hum 18.4 km/h ENE

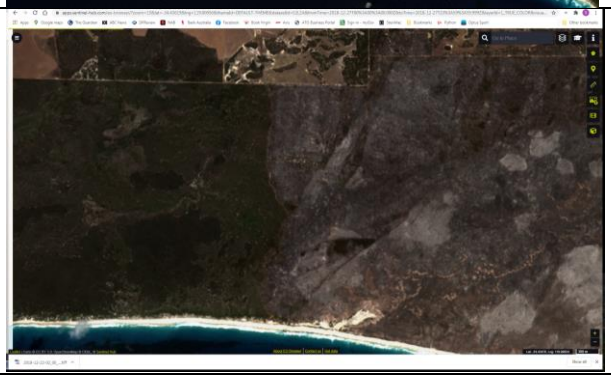
1350	Fire now over approximately 600ha.		27.7C 30% hum 24.1 km/h E
1730	"the fire had burnt through 1000ha" (PerthNow.com.au).		
1800			21.4C 56% hum 27.7 km/h ESE

Saturday December 22nd 2018			
0109	Satellite imagery suggests fire continues to grow slowly overnight, size now over 750ha approx.		11.6C 90% hum 11.2 km/h ENE
0200	Wind begins to shift - from ENE to NNE		13.3C 81% hum 16.6 km/h NNE
0300	And to N, slowly increasing in speed.		12.9C 80% hum 20.5 km/h N
0600			16.6C 61% hum 22.3 km/h N
Morning	Handover from Shire to DFES.		
AM?	Two Helitaks (helicopters) were on site according to Anthony Thomas (time unsure)		
0900	Temperature increases steadily, while humidity drops. Winds freshen from the NNW, blowing the fire in the direction of Bremer Bay.		29.2C 21% hum 25.9 km/h NNW
1000			32.3C 16% hum 20.5 km/h NNW
1000-1100	Sentinel 2 SWIR images. Note that at this time the fire is only on the eastern side of the sand blow, and isolated from the western extender of the ultimate fire extent by burnt areas. There was an effort to get a dozer through		

			
1000-1100	True colour image (Sentinel 1) shows nil fire activity on the western edge. Tracks existed that could have been used to edge the fire using the NW breeze at that time. Clearly this was not done.		
1029	Satellite imagery (Sentinel 1) shows very rapid fire growth under influence of NNW winds, rising temperature and dropping humidity.		
AM	At about this time, the plan was to pinch the fire off at its western edge at the top of the large sand blow. However it was not possible to push a track through the sandy country. (Anthony Thomas).		
		 Mia and Ava Benson watch the Bremer Bay fire. Credit: Keiron Benson Albany Advertiser	
1100			33C 14% hum 13 km/h NNW
1200			35.4C 10% hum 13 km/h NW
1300			35.3C 9% hum 13 km/h WNW

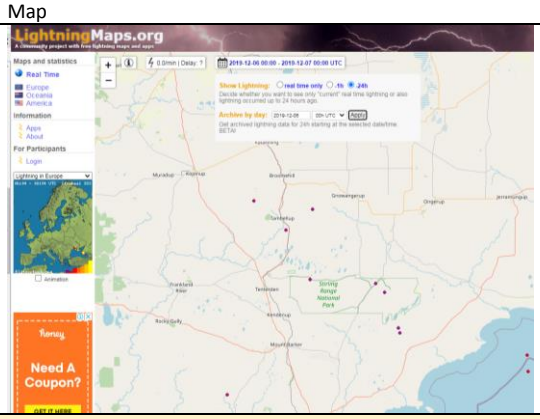
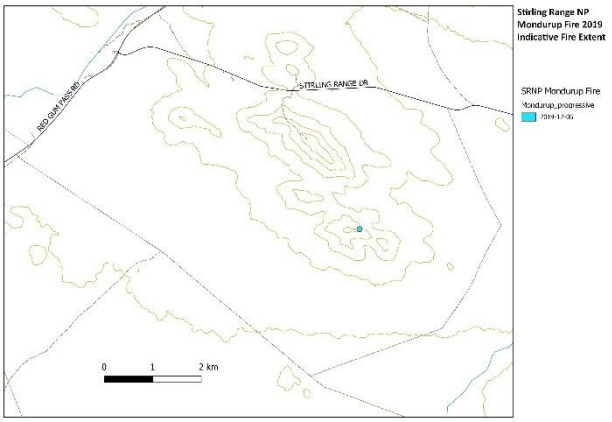
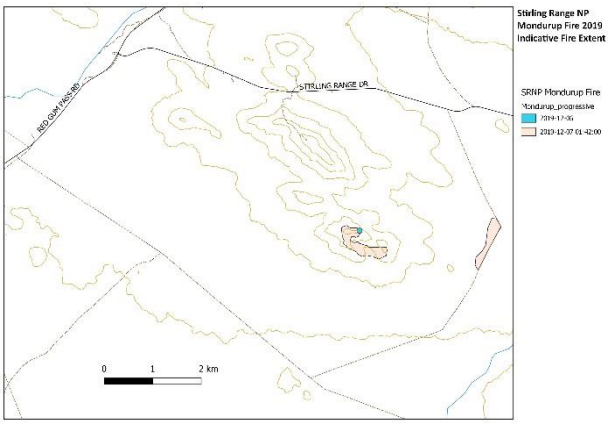
1330	Fire area now over 3000 ha. Fire continues to extend on the eastern wing, but now there is a new fire area developing on the west of the top of the fire (arrowed). Satellite images show this part of the fire had little activity at 10am, and the wind is mainly from the west. However the inability to clear fire breaks and back burn from these meant the fire could run west, which it did rapidly in the SE winds.		
1400	Wind shifts from WNW to WSW. Humidity stays very low. Temp peaks		36.8C 8% hum 11.2 km/h WSW
1445	Fire has shifted to the west… Over 5700ha. (MODIS Aqua satellite – less accurate)		
1500			35.8C 8% hum 9.4 km/h SE
1600			36.1C 8% hum 5.4 km/h S
1800	Humidity begins to rise, while winds now drop through until 2300.		31.5C 16% hum 27.7 km/h E
2000			26.1C 22% hum 20.5 km/h ENE
2232	Fire continues to spread with E wind. (MODIS Terra satellite – less accurate)		20.3C 32% hum 5.4 km/h E

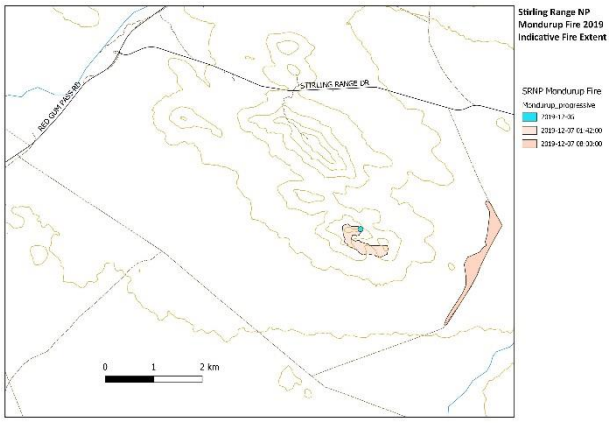
Sunday December 23rd 2018			
0050	MODIS N satellite pass indicates fire over 8000ha in area.		

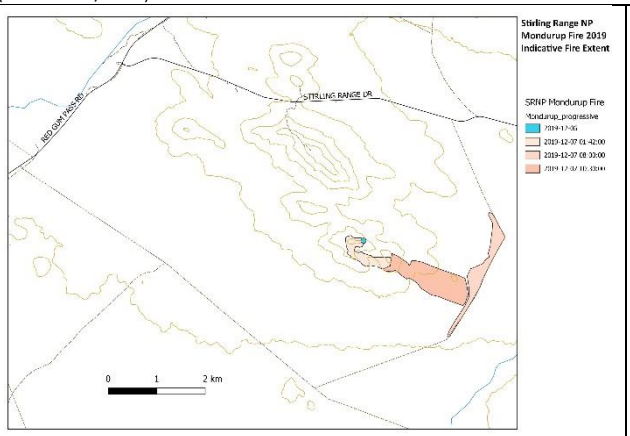
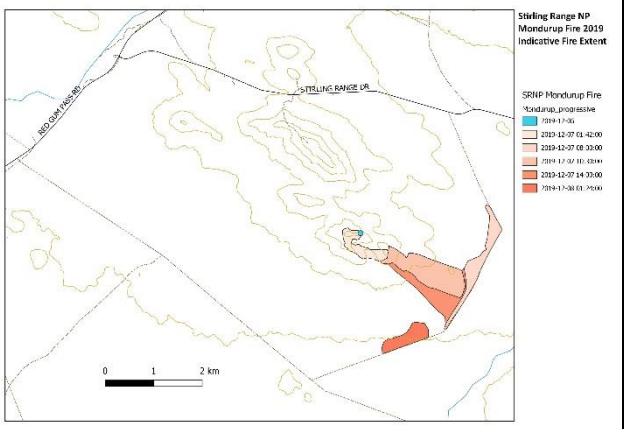
Thursday December 27th 2018			
1000	At around this time, the fire reaches its fullest extent. Very limited activity (smoke) can be seen on the eastern margin of the fire.		
	It appears that the fire has been contained on the western edge with a firebreak, shown in this image (Sentinel-2 10am 27/12). This feature does not apear on more recent imagery, so its likely it was superficial.		

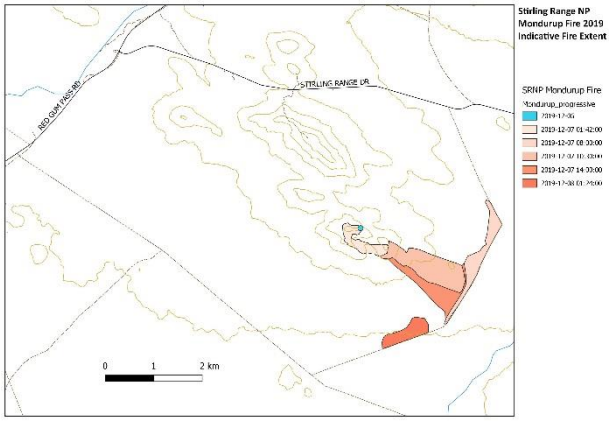
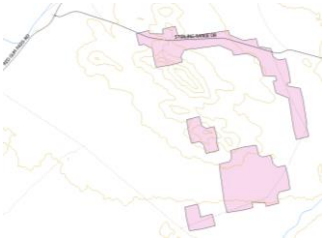
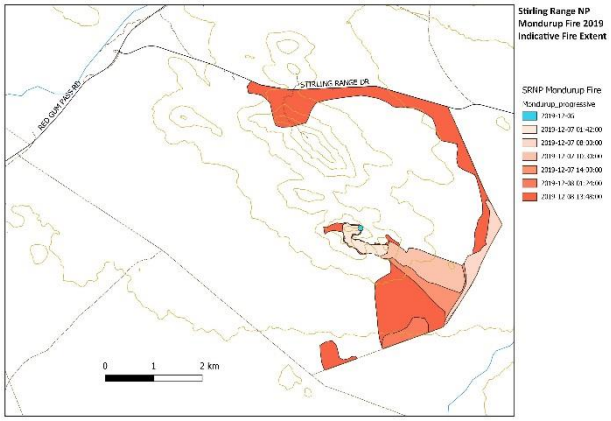
Mondurup Fire – December 6 2019

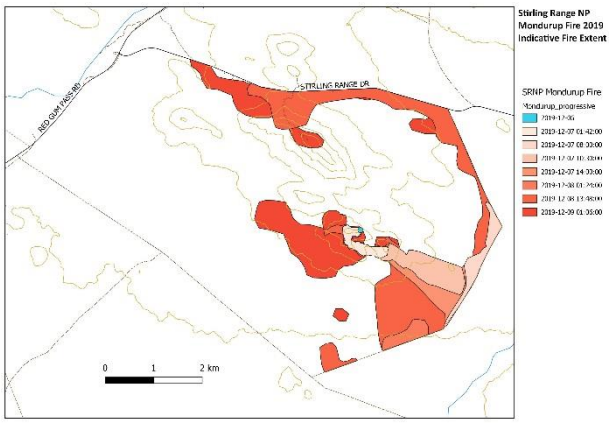
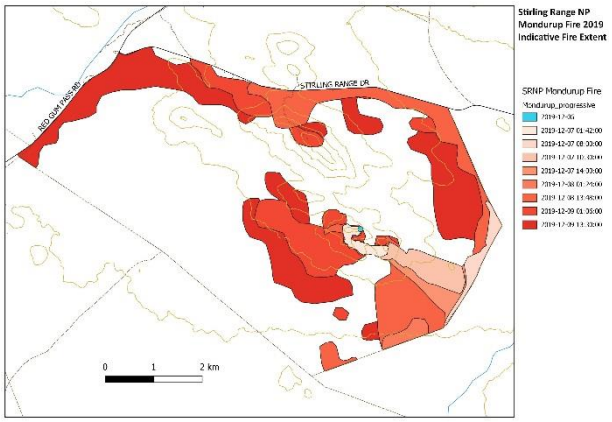
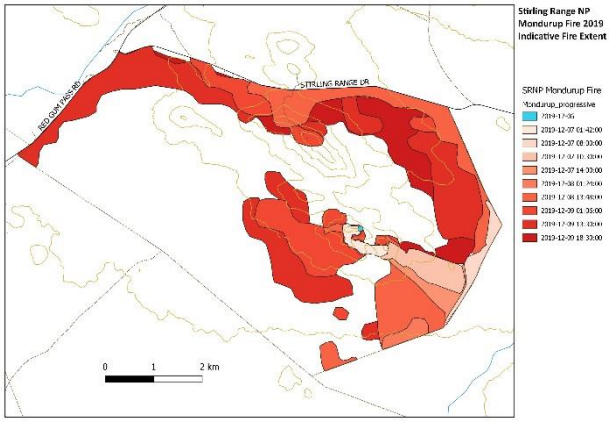
Extents are indicative, taken from different satellite sources, and with low resolution data (VIIRS/Suomi NPP 375m satellite or MODIS Aqua & Terra Satellite downloaded from MODIS website) in most cases. Not all fire extent may be mapped due to the time fires grew and the satellite passes.

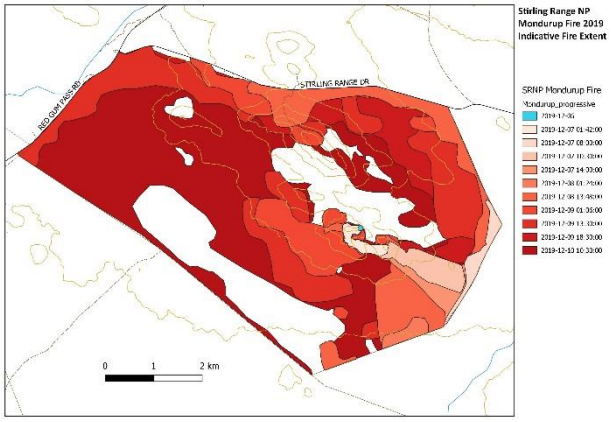
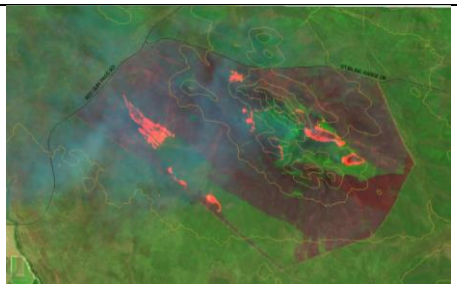
Time	Description	Map	Weather
	Lightningmaps.org shows strike in the vicinity and in the park. Does not show specific strike on Mondurup.		
Friday December 6th 2019			
5.30-6pm	Lightning strikes north of Little Mondurup Peak. Fire described as "very small, stationary, but "very dangerous" (Tim Saggers)		25.1 °C 52% hum, 24 km/h ENE
Evening	Reported evening of the 6th.		
Night	2 truck/DBCA crews on site that evening – worked during the night to back-burn from the eastern edge.	Edging along Eastern boundary was intended to stop fire as it came down off the mountain in the forecast WNW wind.	
	Equipment massed for back burning work following day (7th).		
Saturday December 7th 2019			
1:42am	MODIS shows fire cell east of the top of Little Mondurup – this may be evidence of movement off the top towards the east.  MODIS heat pixels		19.2 °C 80% hum, 1.8 km/h W
6am	Lots of 4WD's observed driving along Red Gum Pass Road – presumably to assess fire.		16.5 °C 85% hum, 9.4 km/h

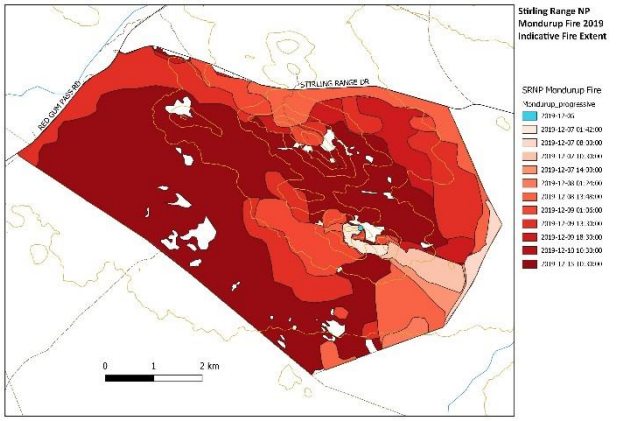
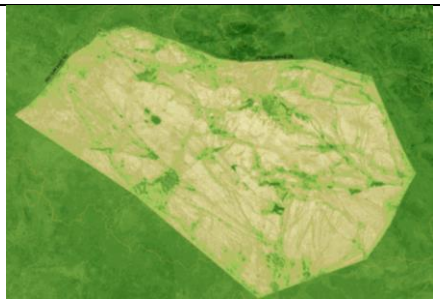
	NOTE – Saggers' believe that no fire-fighting occurred. Clearly not true.		NE
7am	Vince Hilder (DBCA Albany Fire Officer) Significant onsite work began.		
0800 Approx	Back burning along eastern boundary preparing for fire run. MODIS imagery shows back burning along the east of the Mondurup block. Back burning more extensive (to the south) than shown in MODIS imagery.		
8:46am	Wind from NW	 Fire burning on Little Mondurup, 0846, 7th December. Val and Tim Saggers	Ongerup: 31.5 °C 73% hum, 11.2 km/h NW Albany: 22.4 °C 54% hum, 20.5 kmh WSW
0900 onward	Fire came down off the top of Little Mondurup, heading in SW direction. Stopped along eastern fire break/back burning. Satellite record suggests major flare-up on the following day, however it appears clear that the satellite images missed the run off the top.		WNW wind on site.
0910	 Fire on the crest of Little Mondurup – beginning to run off the top. (Vince Hilder/DBCA)		

1234	Fire having run off the top of Mondurup during the morning. Back-burning can be seen in the foreground – compare fire intensity to main fire.	 (Vince Hilder/DBCA)	
1230			WNW wind on site.
1400	Fire has extended southward with ENE wind, additional back-burning seen to the south of the fire run.		Albany: 14.3C 92% hum 18.4 km/h ENE
1500			19.9C 70% hum 29.5 km/h W

Sunday December 8th 2019			
0124	MODIS satellite heat imagery shows very little heat high – only off the east of Little Mondurup. Remnants of fire run and back burning seen to the SE. 		Albany 14.2 °C 86% hum, 13 km/h W
0800	Wind swings to SW, and is forecast to change to SE by the 9th. Concerns that this would push fire north led DBCA to begin back burning along the northern boundary.		Albany 16.8 °C 64% hum, 25.9 km/h SW
1317	Back burning along south-east and northern parts of Mondurup Block well established. DBCA noted that the fire along the northern boundary burning hotter than hoped, up the northern flank for Mondurup. Said this was caused in part by eddy winds in the SW breeze.	 View from south-west showing back-burning in full flight. Photograph suggests that fire on Little Mondurup is not very active – but is still burning. Val and Tim Saggers.	Albany 19.7 °C 47% hum, 22.3km/h SSW
1348	MODIS Satellite Fire imagery shows extension of burning from back burning along Stirling range drive (to the north) and the south-eastern boundary track. Fire has also extended along the crest of Little Mondurup. 		
1500			19.7C 50% hum 24.1 km/h SSW
1800			16.9C 60% hum 16.6 km/h SSW

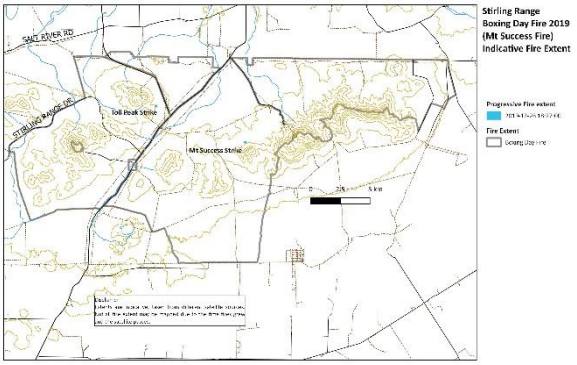
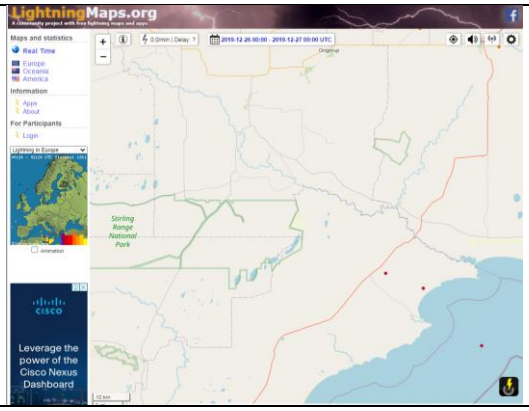
Monday December 9th 2019			
0106	The fire spreads to the west of the original strike on Little Mondurup. Fire continues to spread slowly from the edging burns.		Albany 7.1 °C 96% hum, 5.4 km/h N
1330	Fire now spreading off Little Mondurup, away from back burning along Stirling Range Drive and eastern road. Back burning was extended to the west along Stirling range drive and then Red Gum Pass Rd to provide protection against the SE wind change forecast for today.		Albany 21.9 °C 45% hum, 20.5 km/h SSE Locally breeze possibly NE
1608	SE wind has come in as can be seen in this photograph.	 4:08 pm. Mondurup from the SW, Val and Tim Saggers	Albany 20.4 °C 53% hum, 24.1 km/h SE (Wind Estimate from video) 10-15kph, E-SE
1830			Albany 18.1 °C 63% hum, 20.5 km/h ESE

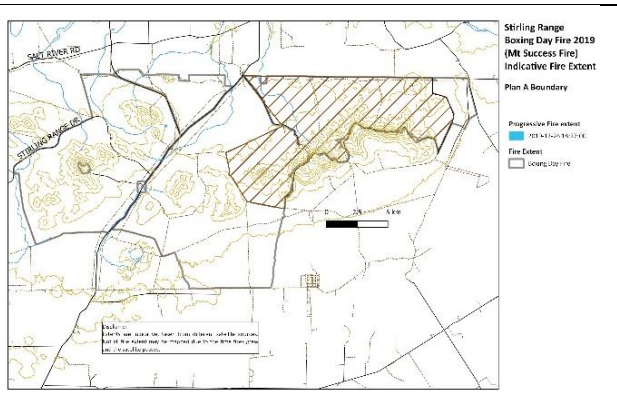
Tuesday December 10th 2019			
0900	Fires coming off Stirling Range Drive and Red Gum Pass Rd are moving across the block into the E wind. Back burns are lit along the southern edge, and later secondary lines of ignition are laid down by helicopter.		Ongerup: 19.8 °C 53% hum, 18.4 km/h E Albany: 19.8 °C 60% hum, 13 km/h ESE
1030 (approx)	True extent of the fire at this time. Satellite imagery (Sentinel-2) shows the fire is still burning.		Albany: 22 °C 52% hum, 9.4 km/h E
1030		 Sentinel 2_L1C_SWIRS Image showing active fire areas (red) and extent of burn.	
1207		 12:07 pm. Mondurup from the SW. Val and Tim Saggers	Albany: 21.8 °C 53% hum, 22.3 km/h SE

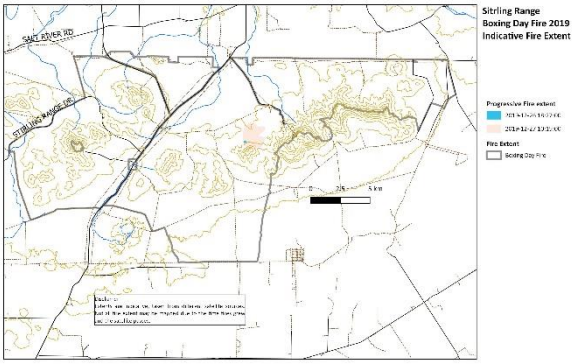
Monday December 15th 2019			
1030	Satellite photographic imagery (Sentinel-2_L2A_NDVI) shows the final extent of the fire. Final area is approximately 3900ha – note that not all areas within the bounding roads are burnt, as has been captured in the mapping, and can be seen from the NDVI image.		
1030		 Satellite photographic imagery (Sentinel-2_L2A_NDVI)	

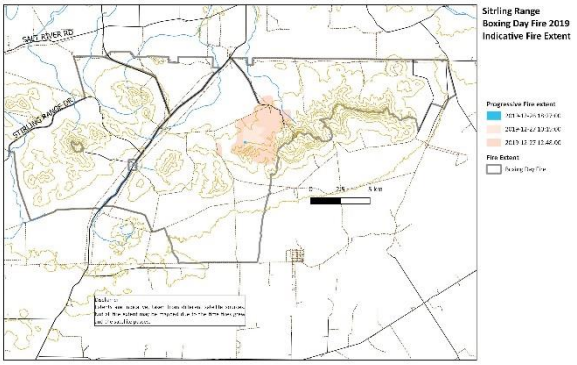
SRNP Mt Success Fire – December 26 2019

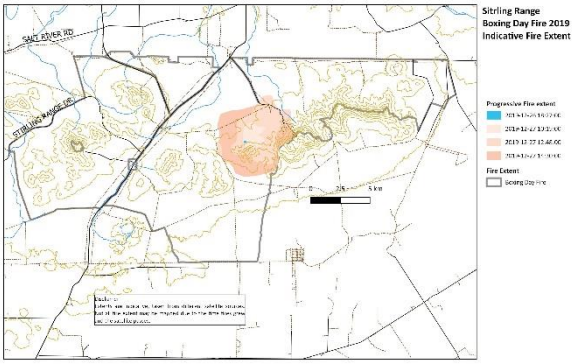
Extents are indicative, taken from different satellite sources, and with low resolution data (VIIRS/Suomi NPP 375m satellite or MODIS Aqua & Terra Satellite) in most cases. Not all fire extent may be mapped due to the time fires grew and the timing of the satellite passes.

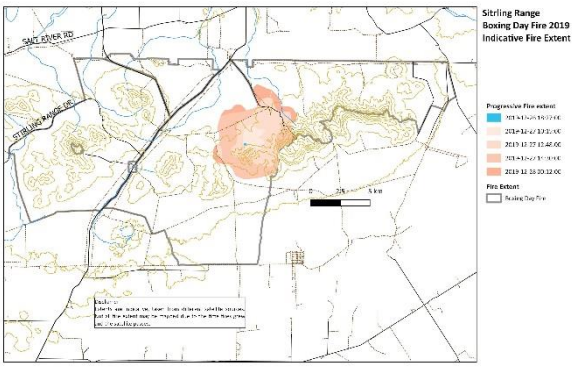
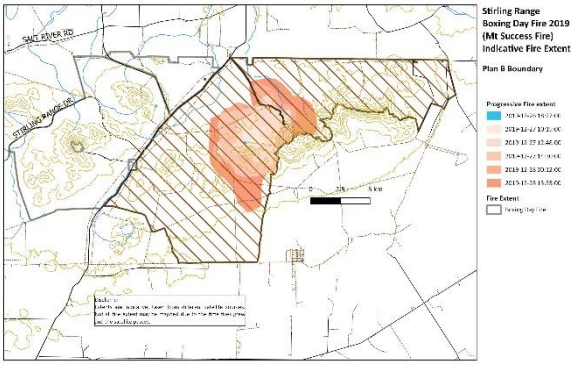
Time	Description	Map	Weather
Thursday December 26th 2020			
1600-1700	Lightning strikes approx. 4pm, "near Mt Success behind the Ranger's house (T Dunham). First sighting: "the fire was spotted at approx. 4.30pm boxing day" (SRNP Recovery Group Facebook Dec 31). An additional strike hit near Toll Peak as shown. This was eventually located at 0100 on the 27th and controlled by 0300.		Albany (5pm): 23.2 °C 72% hum, 24.1 km/h SW
	Lightningmaps.org shows strikes to the SE of the park. Does not show specific strike on Mt Success, but the track indicated by the three strikes shown would extend back towards all three of the sites when fires started (Mt Success, Toll Peak and Carmel Lake NR).		
1720-1730	Duty Manager DBCA notified of a fire at Carmel Lake north of the park following lightning.		
1720-1730	Duty Manager DBCA pre-notifies DBCA Air Attack Supervisor in Albany. Aerial support requested at this stage – initially for Carmel Lake Fire.		
1800	Duty Manager DBCA notified by a Volunteer Ranger with confirmed siting and location for the Mt Success fire. Ranger expressed concern that there were cars in the Bluff Knoll carpark.		
1800	2 Water bombers & Air Attack Supervisor airborne from Albany.		
1815 approx	Water bombers turned around in the vicinity of the Porongorups due to storm activity ahead.		

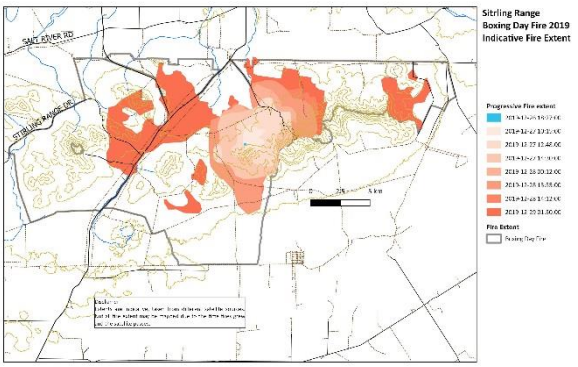
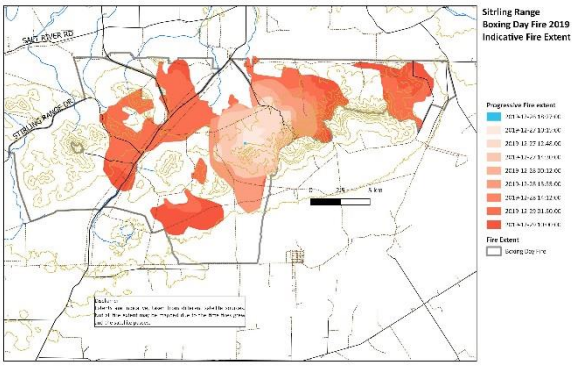
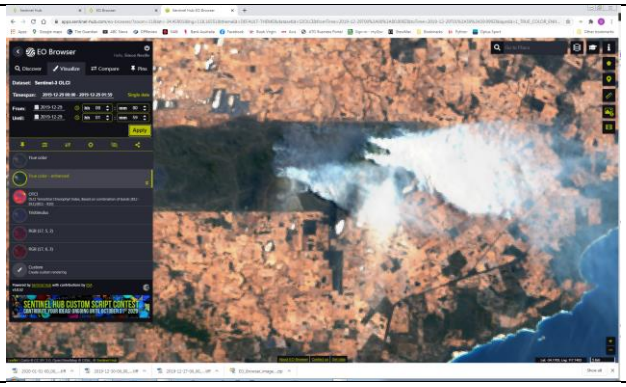
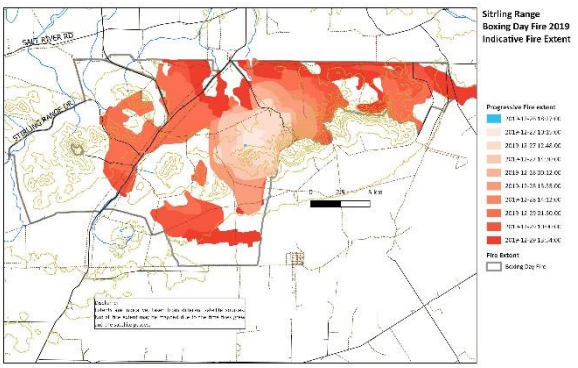
1800-1830	Fire assessed as being uncontainable in its initial location. DBCA develops an initial plan [Plan A] to hold fire along available roads and the fire boundary from the 2018 fire in the SE of the Park.		
1827	Fire photographed from the NE by Terry Dunham. Bluff Knoll Rd blocked off due to fire (Facebook).		Albany (6pm): 21.3 °C 80% hum, 24.1 km/h WSW
1830	"Bluff Knoll Rd was blocked off at around 6.30 because of the fire." (SRNP Recovery Group Facebook Dec 31)		
1914	Fire is travelling up the slope of Mt Success. Smoke plume indicates significant increase in size. Fire photographed from the NE by Terry Dunham at 7:14pm		Albany (7pm): 20.7 °C 81% hum, 20.5 km/h WSW
2030	"It was well and truly alight by 8:30pm." (SRNP Recovery Group Facebook Dec 31)		
Over Night	Edging was being carried out by DBCA around Bluff Knoll assets and along roads to try and provide capacity to keep fire within Plan A.		

Friday December 27th 2020			
0530	Bulldozer and fire crews observed driving up from Albany. (T Dunham)		
0538	Dawn sees the fire well established and having burnt up the north side of Mt Success.	 Looking across from Bluff Knoll Carpark at dawn. (Vince Hilder/DBCA)	
1015	Fire appears to have burnt in a NE direction from the initial strike. Its area is estimated to be 315 ha at this stage. First Response - Fire crews are on site and back burning along Bluff Knoll Road. This fire is in the order of 8ha. Multiple Units have been called in, including dozers. Fire extent map based on Sentinel-2_L2A_SWIR imagery, showing initial back-burns along Bluff Knoll Rd, and lightning strike extending NE.		Albany: 25 °C 55% hum, 18.4 km/h W
1024	View from Bluff Knoll car park looking west. (Vince Hilder/DBCA)		
	According to Greg Mair, DBCA Regional Manager and the duty officer in charge of the fire at the beginning, water bombers were on site from today (27th) onwards. They were providing water bombing support for all back-burning activities. There were at least 4 water bombers in attendance.		

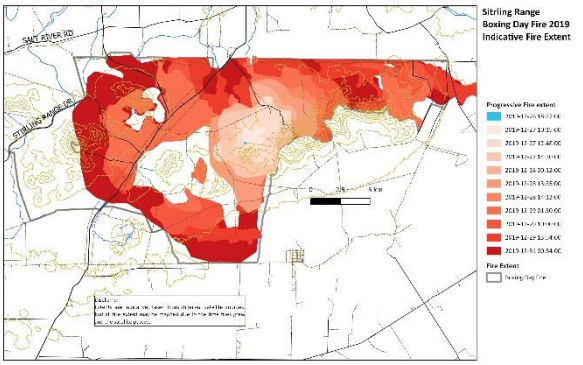
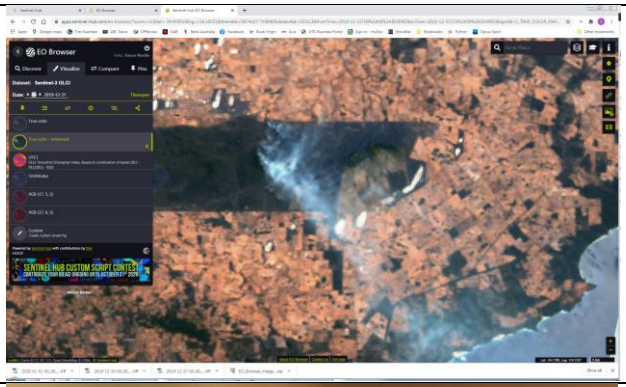
1149	Fire photographed from the WNW by Terry Dunham 11:49am		Albany: 22.7 °C 61% hum, 29.5 km/h SSW Local wind looks NW
1248	Over 3 hours the initial fire has extended dramatically, while back-burning along Bluff Knoll road has escaped to the east. The main fire has increased in size to over 1700ha, and appears to have joined with the back burn.		Albany: 22 °C 62% hum, 33.5 km/h SSW
1248	Fire photographed from the NE by Terry Dunham 12:48pm		Albany: 22 °C 62% hum, 33.5 km/h SSW
1300 approx.	View from the Rangers Station (Vince Hilder/DBCA).		

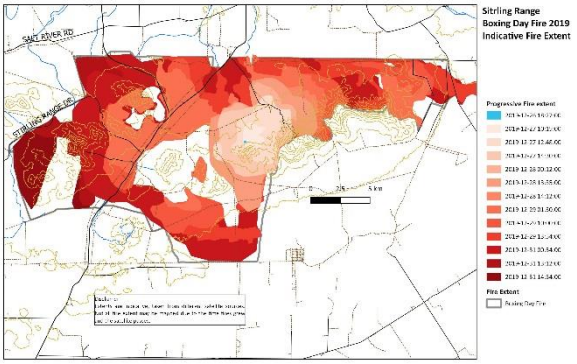
1430	Fire is spreading to the west, main fire over 3,000-ha.		Albany: 24.1 °C 49% hum, 22.3 km/h SW
Afternoon	"I returned that afternoon and saw the fire was now out of control. Crews were back burning in the paddocks opposite me to try keep it contained. . it got worse." (SRNP Recovery Group Facebook Dec 31)		
1700	Police evacuate the Stirling Range Retreat. (T Dunham)		

Saturday December 28th 2020			
0012	Fire spreads slowly to the East and North during the night.		Albany: 16.1 °C 78% hum, 11.2 km/h WNW
0900-1000	Sentinel-3 OLCI satellite – 0900-1000 WST – NW breeze indicated.		
	Start of Aerial attack - thought to be incendiaries (T Dunham).		
1200			Albany 27.2C 36% hum 14.8 km/h W
1335	The fire is now in the order of 5,500 ha. The fire has broken through the initial Plan A boundary to the north and along the southern front. At this time it is assessed that the fire cannot be held to the Plan A area, and DBCA decide to fall back to Chester Pass Rd [Plan B].		Albany: 26.3 °C 47% hum, 22.3 km/h S
1500			Albany 25.6C 51% hum 24.1 km/h WSW
1600 approx	Central areas of the park experience a SE breeze, rapidly moving the fire to the N/W. Before it is possible to begin back-burning along the road, the fire jumps Chester Pass road, and makes significant progress west of Chester Pass Road. Back burns are begin in the east of the park to try and protect PP to the east from a run to the east.		
	People returned to Stirling Range retreat to check pumps etc, but were re-evacuated. Ranger one of those evacuated.		
Late Afternoon	The advancing fire burns out Moingup Springs Rangers Area, including equipment from the Incident Control Vehicle stationed there.		

Sunday December 29th 2020			
0135	At 1:35 am, the satellite data suggests the fire has increased to over 10,000ha, including extensive areas to the west of Chester Pass Road. Back burning is started in the east of the Plan B area in preparation for the fire extending to the east with forecast W winds.		Albany: 13.4 °C 96% hum, 16.6 km/h N
	"Long hot windy day"… "fires ranging out of control" (Facebook)		
1000	Fire continues to extend to the east of Bluff Knoll Rd, as well as at the eastern end of the park. Total fire area now over 15,000 ha.		Albany: 25.6 °C 48% hum, 35.3 km/h W
	29/12 Sentinel-3 OLCI satellite – 0900-1000 WST – W breeze.		
1354	DBCA oversee back burning along the northern edge of the fire area. Greg Mair (DBCA Duty Officer) notes that this was despite pressure from "Day 1" to burn by landowners. According to him they burnt this only when they thought it was best to do so.		Albany: 28.5 °C 36% hum, 38.9 km/h W

Monday December 30th 2020			
0900	Fire fighting continues.		Albany: 18.1 °C 61% hum, 18.4 km/h SW
	Staff returned to Stirling Range Retreat		

Tuesday December 31th 2020			
0054	Fire extending west.		
0900-1000 am	NW breeze locally (Sentinel 3 satellite).		Albany: 20 °C 52% hum, 18.4 km/h WNW
1134		 Fire photographed by Terry Dunham 11:34 am	
Noon	Lower SW corner has back burns put in rapidly ahead of a SE sea breeze which would have otherwise pushed the fire to the north and west of Stirling Range Drive. According to DBCA this was conducted at speed, and the back burns were hotter than they would have liked, but that it was necessary to avoid the fire crossing Stirling Range drive and continuing north and west.		Albany 25.7C 31% hum 16.6 km/h W

1454	Total area burnt now nearly 30,000ha.		

Fire Overviews

Primary Fires

Fire	O'Sullivan	Cascade Scaddan	Waroona (Fire 68)	Bremer Bay	Mondurup	Stirling Range Boxing Day
Fire Date	January 30th 2015	November 15th 2015	January 6th 2016	December 20th 2018	December 6th 2019	December 26th 2019
Cause	Lightning (Day Jan 28th)	Lightning (0500 Nov 15th)	Lightning (Evening Jan 5th)	Lightning (December 16th)	Lightning (1730 approx. Dec 6th)	Lightning (1600 Dec 26th)
First Report/Elapsed Time	0955 30th/2 days	0900 15th/4 Hours	0630 6th/approx. 6hrs	1123 20th/4 days	1800 6th/30 mins	1630 26th/30 mins
Initial response	1000: 2x fixed wing 802 Air Tractor water bombers (P&W) suppressing initial blaze.	1200: Operator A commenced mobilisation of Bulldozer A to the Fire Ground. 1430: Operator A and Bulldozer A arrived at the Fire Ground. 1630 – Bulldozer A still waiting addition machinery. Plan A no longer viable due to fire spread. 1800 Bulldozer began work on track clearing. Water Bombers were requested from DFES on 15/11 but were not available. DPaW records suggest first request to them on the 18th.	0720-30 Four 4WD heavy fire vehicles and one front end loader mobilised. 0745 Four water bombers – focus their suppression activities on Fire 68, with the aim of holding it until ground crews could gain access. 0830 Eight 4WD trucks, 2 dozers, 2 front end loaders. 0845 Helitaks requested by P&W to help fight the fire. 0942 Aircrane requested by P&W to assist in fighting the fire.	4 heavy fire trucks, smaller farm fire units. Later in the afternoon, front end loader used to edge fire to the north.	1900 onwards: 2 trucks/DBCA crews worked during the night to back-burn from the eastern edge.	1800 Water Bombers requested (initially for Carmel Lake Fire) 1800 onwards: DBCA crews on site 1815 approx. Water bombers turned around due to weather.
First Responders	DBCA	Local Farmers/Brigade	DBCA	Local Brigades, Shire	DBCA	DBCA
Elapsed time from Report to initial response	1hr	13 hours.	1 hrs.	1 hour	1-2 hours est.	1hr
Effectiveness of Response	High initially. According to DFES MIR, "Water bombing was successful in containing the initial blaze." However ground attack did not occur initially. The terrestrial resources that responded were diverted to other fires of more threat.	Low – Fire spread had rendered initial containment plan (A) "unviable". Note: PLAN A was for Bulldozers A, B & C to create a track through the bush on the UCL to the Fire during the night so that the Fire could be accessed and contained on Monday morning.	Low - water bombing alone not sufficient to stop the fire travelling west towards the Murray River.	Low – unable to contain fire. No water bombers used on day 1, although they were flying on day 2 (21st), while helicopters were involved on day 3 (22nd).	Low – not possible to attack fire site (top of peak) – so back burning to prepare for the expected run of the fire East off the top of Little Mondurup. Major back burning along the northern boundary starts on day 3.	Low – not possible to attack fire site (slopes of Mt Success) - work only on back burning.
Reason	Ground crews could not access the fire until a track could be cleared.	Breakdowns, distance, difficult terrain. Remoteness of fire ground (14km+) in UCL), spread of fire due to time elapsed.	Ground crews could not access the fire until the upwind fire (69) was rendered safe – this wasn't complete until 1143, by	Inadequate bulldozer for the difficult terrain.	Fire on top of peak. WNW wind change forecast.	Fire on slopes, accessibility, timing (late afternoon).

			which time fire 68 had crossed the Murray River.			
Was a Fast Attack Possible?	Yes, and was carried out with water bombers in the first instance. But was not followed up by ground attack as access was not available.	Yes. Fire in light fuels, very small overnight for 2 days; Water bombers requested on day 1 and 2 (0900) but not available.	Yes, and was carried out with water bombers in the first instance. But was not followed up by ground attack initially due to proximity of fire 69.	Possibly – fire 1km in UCL. Water bombers may have been able to slow advance while better dozer sourced. Better dozer!	Possibly – but only by air, and probably not until following day due to timing. Site gave DBCA no expectation of being able to suppress fire. DBCA would not send fire crews into the location due to danger.	Yes – but only water bombers, and these were unable to continue to the Stirling Range due to weather. DBCA would not send fire crews into the location due to danger.
Key Events	30/1: PM Bulldozer intended to provide fire access track broke down, and hampered the effort to make a direct attack. 31/1: Fire escalated during the day and continued during the night. By midnight the fire was crowning and spotting up to 200m ahead of the main front. 01/2: early Wind shifted back to ENE and increased in strength 02/2: Markedly more severe fire intensity – Northcliffe under threat 04/2: AM Fire crossed SW Highway 05/2: Cool SW change slows the westerly spread.	16/11: 0700 Fire observed to have died down overnight. 16/11: 0900 CFCO requests water bombers. 16/11: 1230 Equipment failure (chain) renders Plan B unviable. 17/11 Fire again dies down overnight (Conflicting reports). 17/11: 0900 Catastrophic fire conditions. 17/11: 1156 Fire jumps from UCL to Farmland. 17/11: 1530: The Fire was upgraded to a Level 2 incident. 17/11: 1641 Four fatalities on Griggs Rd. 17/11: 1920 Upgraded to Level 3.	6/1 1130 Fire 68 jumps the Murray River, marked escalation in fire and response. 6/1 1143 Fire 69 is contained. (Ground attack possible) 6/1 1530 Incident level to Level 2. 6/1 1900 Pyrocumulus activity 6/1 2215 Incident to Level 3 7/1 0800 Main fire into Hamel 7/1 1450 Total resources include 175 personnel, 100 appliances and 23 earthmoving machines. 7/1 1916 Fire enters Yarloop. Strong easterlies affecting fireground, esp Yarloop 7/1 1930 Many buildings ignited in Yarloop; two lives lost.	20/12: Fire not held at start. 22/12: Wind Changes to NNW, strengthens on hot day. 22/12 morning: Shire Handover to DFES 22/12: afternoon (1330+) Fire escapes to the west with SE change after efforts to create firebreaks fail.	07/12 Strategic back burning of Eastern boundary of Mondurup block 07/12 Fire comes off Little Mondurup, held on eastern fire breaks. 08/12 Extensive back burning of Eastern and Northern boundaries of Mondurup block	27/12 Back burning along Bluff Knoll Rd. 27/12 Fire extends dramatically out to 1700ha. 28/12 Strong SE sea breeze; Fire jumps Chester Pass Rd 29/12 Overnight imagery indicate fire size now over 10,000ha. 29/12 Northern edge alight (back-burning). 29/12 Fire extends significantly to the west in a westerly wind – back-burning from Stirling Range Drive.
Other factors	Bulldozer breakdown. High number of other fires at the same time took resources away.	Equipment breakdown Simultaneous significant fires (Local - Merivale near Esperance, and Cape Le Grand, many FESA fires elsewhere) Catastrophic weather Poor Coordination and Lack of Support	Proximity of fire 69. Extreme and unusual fire weather conditions.	Wind change	Containment policy considered successful.	
Result	Fire burnt 80,000ha.	Four deaths; fire escape to 80,000ha, massive PP damage	Fire burnt 69,000ha	Fire Escape to 10,000ha	Fire burnt over 6,000ha – but was held in the Mondurup block.	Fire burnt over 40,000ha

Table 1 - Primary Fires Overview

Secondary Fires

Fire	O'Sullivan	Cascade Scaddan	Waroona (Fire 69)	Stirling Range Boxing Day- Toll Peak
Fire Date	Multiple other fires!	November 15th 2015	January 6th 2016	December 26th 2020
Cause		Lightning	Lightning (Evening Jan 5th)	Lightning (1600 Dec 26th)
First Report/Elapsed Time		0700 15th/2 Hours	0630 6th/approx. 6hrs	0100 27th/ 9 hours
Initial response		BFB Crews and farm machinery (Loader) used to contain small spot fire.	0720 Four 4WD heavy fire vehicles and one front end loader. 0830 Eight 4WD trucks, 2 dozers, 2 front end loaders.	1800 onwards: DBCA knew there was a small fire in the vicinity – finally seen at 0100 near Toll Peak. Bulldozer mobilised and fire edged, complete 0300.
Elapsed time to response		2 hours	1-2 hours	9 Hours
Effectiveness of Response		High – Fire extinguished rapidly	Good – fire extinguished in 5 hours	High – Fire extinguished
Reason		Fire small and accessible, fast ground attack completed.	Focus of ground resources	Fire small and accessible, fast ground attack completed.
Was a Fast Attack Possible?		Yes.	Yes	Yes.
Key Events		Early detection Fast attack. Good access	Early detection (Landgate 'Firewatch' website) 0720 Direct attack while still small (6ha approx.) 1143 Fire 69 is contained. Containment was achieved through ground based direct attack.	Early detection Slow development Good access
Other factors				Visible when still small.
Result		Successful containment	Successful containment, but partly responsible for fire 68 getting out of control.	Successful containment

Table 2 - Secondary Fires Overview

DISCUSSION & CONCLUSIONS

Individual Fires

O'Sullivan (Northcliffe) Fire

The O'Sullivan fire occurred as a result of lightning strikes that caused at least 15 fires, in addition to four other existing fires and eleven active prescribed burns. So Parks and Wildlife were already stretched when it was spotted by air. Nonetheless, Parks & Wildlife sent water bombers and an air attack supervisor in a fixed wing aircraft on January 30th within an hour of the sighting – so there was a fast attack on the fire, one which apparently "was successful in containing the initial blaze". But there was no ground-based attack at that time.

In a number of conversations with both DBCA and DFES staff, it has been made clear to us that aerial attack alone is not what puts fires out. In most cases it is used for suppression and to assist ground attack. The catchcry - "water bombers don't put fires out – people do" has been heard a number of times.

So the lack of any ground attack at that time – due to a combination of the diversion of terrestrial resources that did respond to other fires, and the breakdown of the bulldozer intended to give ground access for a direct attack – appears to be a failure of the fast attack process.

In part this was a failure to correctly assess the danger on that site: the diversions of resources were to other fires burning in older fuels that were judged to pose a greater immediate threat to property and infrastructure (DFES 2015). In hindsight this was mistaken judgement. But the failure was also due to insufficient resources to provide for crews to all fires, and indeed to cover for the bulldozer breakdown.

One has to ask about the number of prescribed burns in the middle of summer, and to what extent this meant there were insufficient crews to properly complete the fast attack. In other words do sufficient resources exist in the area to meet the growing fire risk, and are they available in the summer and not already committed to non-fire-suppression activities? One also has to ask how resourcing will face the greater challenges in future as climate change causes longer and more severe fire seasons.

So was it a failure of 'fast attack'? It is possible to argue this, but the lack of both aspects of fast attack (ground attack with aerial support) was not due to a lack of intent. It is simply that the resources to do so were not fully available.

Was it a failure of resourcing? Almost certainly.

Cascade-Scaddan Fire

The Cascade-Scaddan fire offers up a number of lessons, some of them very grim. The first is that the fire almost certainly could have been put out by fast attack – if that had been possible. The example of the first fire the morning of November 15th is that a rapid response on site was sufficient – no water bombers were required, just a loader to run a mineral earth break around the fire and then crews from the Cascade and Munglinup BFBs to extinguish it.

The significant fact about the second fire – the Cascade-Scaddan fire – was its isolation. The lack of any remote area fire-fighting capacity in WA meant that ground attack required the provision

of access, which meant pushing through tracks for at least 6km from the south, or 10km from the east (Ned's Corner). The original plan was for "Direct attack, construct a fire line and contain the Fire within the lake system – Track approximately 10km to access and complete approximately 5km of fire line to contain the Fire (Strategy Option 1)" (Pacer Legal, 2016:11). In fact while the distance estimates were accurate, this would take much longer – even the access Rd used (Pyramid Track) required bulldozing due to its poor condition, adding another 6km. And the first bulldozer (Bulldozer A) didn't actually arrive at the beginning of Pyramid Rd until 1800 on Sunday – 13 hours after the first report. The DFES report notes the time taken for machinery to arrive, and the difficulty of ground access, including a machine being "caught in the boggy terrain of the lakes system" (Nous Group 2016:16). DFES also note that firefighting resources were under a great deal of stress in the district due to the number of active fires, both locally and around the State.

In the absence of ground attack, and with no water bombers available, the fire continued to burn, and increase in size over the next two days – and particular on Tuesday 17th – to the point that it was not containable. The isolation is critical, as the evidence is that it was relatively small for some time – even up to Tuesday morning. We are not able to say when aerial and direct ground attack would have no longer made a difference, but clearly a less isolated situation could have been easier to reach.

Even given the remoteness of the fire, during the morning of the 15th the CFCO "was feeling relatively optimistic at this time as the plan was "certainly doable" as the conditions were good and they had already easily executed a similar plan that morning" (Linton 2019:13). At that stage the fire was at a low level, as indicated in the photographs in the timeline. It was at this stage that there were discussions about water bombers between the CFCO and DFES, but the DFES Area Officer suggested they were unlikely to be available due to other incidents in the South-West. The Area Officer was advised on Monday at 1440 that water bombers would not be available at all.

In addition, although there were DPaW water bombers in Albany, they were used constantly to assist in the containment of the bushfires near Albany. DBCA Regional Manager did not recall receiving any request for water bombers from DFES in Esperance over this time, and according to DPaW records, the first request came through on the morning of Wednesday, 18 November 2015, after which the water bombers were subsequently deployed to Esperance. In addition, as was raised in the Coroner's Inquest, local agricultural aircraft that were available and capable of doing water bombing were not permitted to take on the task for various reasons.[2]

Even "had aerial suppression resources been available prior to the escalation of fires on 17 November, they would most likely have been deployed to the Merivale fire" due to its higher assessed risk (Nous Group 2015:31).

So for the key period on Sunday and probably through to Monday, there was no possibility of aerial attack. Note that on Monday morning, when the CFCO reviewed the situation in a light

[2] "Local agricultural spray planes … were not permitted to be utilised by DFES as they did not meet Civil Aviation Safety Authority (CASA) Regulations at the time to operate legally". (Linton 2019:84).

plane "He took photos of the Cascades fire and it appeared almost completely subdued, with just one remaining spot fire"(Linton 2019:10). If water bombers had been available, they could have attacked these spot fires, as conditions were clear and smoke minimal. Without ground attack, we don't know if they could have put out the fires, or affected the outcome, but the feeling among affected parties in Esperance is that they could have. According to the Coroner, they "may have been of some assistance in subduing and delaying the fire spread if done at an early stage, like Mr Carmody desired" (Linton 2019:79). Dr Neil Burrows, an ex-DBCA Fire scientist agreed: "Dr Burrows was in general agreement that water bombers would never have put out the fire completely, but noted they may have bought the firefighters on the ground a little more time by slowing the fire up, which would have given the firefighters more time to create the buffers".

There is no discussion in the Coroner's report about the impact of water bombers at the very beginning. However the CFCO did believe that "if the requested resources had been available in a timelier manner, and they had been assisted by water bombers … they may have been able to reduce the fire and prevent it from being as wide-ranging as it ended up being". (Linton 2019:80). Unfortunately, even though there were six water bombers (DBCA) and two helicopters (DFES) in the Great Southern in November, none were actually available due to calls from other fires. And most importantly, none were used.

In the light of this the Coroners' recommendation for additional air capacity in Esperance is important:

> Recommendation 9
>
> I recommend that the WA Government, via DFES or whatever is the relevant agency, undertake an assessment of established airstrips in the north-western quadrant of the Esperance Shire, with a view to identifying airstrips that can be enhanced to permit operation by water bombers. Once a suitable site has been identified, priority should then be given to funding the necessary upgrades to make the airstrip(s) suitable for that purpose.
>
> Recommendation 10
>
> I recommend that the Honourable Minister for Emergency Services and/or the Honourable Minister for Environment, depending upon whose portfolio water bombers actually falls, give priority to funding (at an estimated cost of approximately $800,000) a Wheatbelt based aerial fire suppression response for the full fire season commencing in the Wheatbelt and concluding in Esperance. (Linton 2019:82-82).

To extend the argument somewhat, IF water bombers had been available, THEN in conjunction with some sort of RAFT (Remote Area Fire Team) the outcome may have been different.

So was this a failure of "fast attack"? Yes. There was a great deal of effort aimed at addressing the fire early, but remoteness meant the fire was not attacked either on ground or aerially.

In the absence of RAFT in WA there is no capacity for ground attack in such a situation.

Waroona Fire

The Waroona fire is one where there <u>was</u> fast attack – within an hour of first sighting, and within probably 6 hours of the actual strikes. However the fast attack – which worked well on one of the fires (Fire 69) - was not complete in the case of the fire that became the Waroona fire (Fire 68). As outlined in the timeline, this was simply due to the unfortunate location of the two

lightning strikes that were burning that morning, and DBCA's understandable unwillingness to put crews on the ground to attack fire 68, in close proximity to and downwind of fire 69.

Instead four water bombers focussed their suppression activities on Fire 68, with the aim of holding it until ground crews could gain access. But the partial fast attack - water bombing alone – was not sufficient not sufficient to stop it travelling west towards the Murray River. Although the upwind fire (Fire 69) – which was about 6ha in size at that time – was extinguished relatively quickly (approx. 4 hours), this was enough time for fire 68 to jump the Murray River, with marked escalation in fire size. The increased response that was now possible was not enough to control the fire.

In hindsight, the strategy followed was careful, understandable, but overly cautious. The fast attack on fire 69 was sufficient to put it out *before it reached the other fire* – fire 68. In the end there was about 850m between the two fires. So DBCA could have fought the latter fire on the ground as well as with aerial attack, and the final result may well have been different.

Figure 18 – Historical satellite imagery showing the eastern edge of Fire 68 and the extent of fire 69 (circled).

It is important to note that even if RAFT were available, the decision could have been to not deploy them. In NSW for example, this decision would be made by the IC at the time, and deployment would depend on the current situation: "If there was a likelihood of a second fire closing in then the ROS of each fire will determine whether RAFT attack both separately or contain them as one fire. We would try that unless a) flames are too large for close containment, or b) they're spreading faster than we could get around them." P Zylstra, pers com.

So was this a failure of "fast attack"? No. The components of fast attack that were possible (aerial bombing) were employed very early.

In the absence of RAFT in WA we do not know if there could have been ground attack on Fire 68 in such a situation.

Bremer Bay Fire

The Bremer Bay fire was notable in the long time that elapsed between the lighting and the first reports: about four days. Had there been the capacity to sense the strike area in this time the outcome would have been different.

The response time to the sighting was about one hour, which is very reasonable. The response was also substantial - 4 heavy BFS trucks and some smaller farm fire units. But because the fire was about 1km off the access road, in UCL, access had to be pushed through with heavy machinery. The bulldozer that was on hand was not sufficient for this. Later in the afternoon, a front end loader used successfully to edge the fire to the north, but by this stage the fire was moving south and out of possibility of containment. The satellite extents suggest that by mid-afternoon it was more than 50ha in size.

No water bombers were used on day 1 – while were called for they were not available. It was felt by a witness that they "might have suppressed the fire enough to get to it on the first day". Fixed wing water bombers were flying on day 2 (21st), while helicopters were involved on day 3 (22nd).

So was this a failure of "fast attack"? Yes. Not only was the fire not addressed directly once discovered, but it burnt for days without being detected. While there was a desire to attack the fire early through ground attack, the resources capable of doing this were not available.

Was it a failure of resourcing? Almost certainly.

In the absence of RAFT in WA there is no specific capacity for remote ground attack in such a situation.

Mondurup Fire

The Mondurup lightning strike was noted almost immediately (within 30 minutes), creating a fire that was described as initially "very small, stationary, but very dangerous". But the location meant that DBCA were never going to mount a ground attack due to the dangerous terrain. DBCA staff are highly sceptical of the capacity for water bombers to suppress the fire enough to stop it travelling off the peak, and as a result water bombers were not called for. The strategy was always to prepare for fire running to the east with wind change in the morning of the 7th. DBCA fire trucks and crews were on site within 1-2 hours of the sighting, and worked to prepare fire breaks.

It is worth noting that DBCA believed that they would be able to contain the fire with the Mondurup block through back burning, and this is what they did. But that they felt that they had "dodged a bullet" through being able to contain the fire – that it had been a very close thing on the first day when the fire ran off the peak.

So was this a failure of "fast attack"? Possibly – we do not know what may have happened if water bombers had attacked the fire very early. But a very difficult location for anything other than a highly-trained RAFT team, and even then unlikely.

In the absence of RAFT teams there is no capacity in WA for ground attack in such a situation.

Mt Success Fire

The Mt Success fire was one of three in the area from lightning strikes around 4pm. The first reported to DBCA was at Camel Lake Reserve, at about 5.30pm. Water bombers were airborne to that fire when DBCA were notified of the Mt Success fire. These water bombers would have been re-directed to Mt Success for early suppression had they not had to run around due to the weather. Again, the location meant that DBCA would not mount a ground attack. The terrain was not so dangerous, but the fire was beginning to travel up Mt Success by at least 7.30pm, and there was no ground access for ground attack. DBCA assessed that the lack of access meant the initial plan [Plan A] would be to hold fire along available roads and the fire boundary from the 2018 fire in the SE of the Park. This meant the fire would inevitably be substantial in size (about 10,000ha).

So was this a failure of "fast attack"? Again, it appears to be a possible case, but complicated by the location.

Is it possible to pre-station water bombers ahead of the squall lines?

We do not know what may have happened if water bombers had attacked the fire - perhaps there could have been a ground attack.

Again, in the absence of RAFT teams there is no capacity in WA for ground attack in such a situation.

Fire Summary – Report Findings

We can summarise the findings for these fires as follows:

Fire	Date	Fast Attack?	Result [Solution]
O'Sullivan	30/1/2015	Yes	Fast attack failed to hold the fire due to resourcing issues. [Better resourcing]
Cascade Scaddan	15/11/2015	No	No fast attack due to no capacity (RAFT)
Waroona (Fire 68)	6/1/2016	Yes	Fast attack failed to hold the fire due to incomplete implementation resulting from the second fire. [Better Luck]
Bremer Bay	20/12/2018	No	No fast attack due to no capacity. [Better resourcing/RAFT]
Mondurup	6/12/2019	No	No fast attack possible due to no capacity in location [Better Location, possibly RAFT]
Mt Success Stirling Range	26/12/2019	No	No fast attack possible due to no capacity (Better Location, RAFT).

Table 3: Fire Summary – Report Findings

Remote Area Firefighting

NSW

Remote Area Firefighting Team (RAFT) personnel are specialist members of fire services (New South Wales Rural Fire Service or National Parks and Wildlife Service; the ACT Rural Fire Service and ACT Parks and Conservation Service) who are particularly effective for work in rugged, isolated areas that firefighting tankers can't access by road. They can then be transported in 4WD before hiking to the fire-ground, or sometimes winched in by helicopter.

RAFTs are skilled in dry firefighting techniques such as creating firebreaks by cutting mineral earth trails or undertaking back burning work.

There are also Rapid Aerial Response Teams (RART), which is a program within the NSW RFS where specially trained firefighting teams (trained RAFT Firefighters) are "placed on standby at appropriate times and in appropriate places, transported by helicopter to the scene of an incident when needed and, if necessary, transferred to the ground by winching or similar insertion". (York & Stephens, 2011:4)

The RART programme was introduced within the NSW RFS in 2011 as a response from the Victorian Royal Commission findings into the 2009 fires. The idea is that when certain weather conditions are forecast a standby RAFT team and a winch capable medium helicopter are mobilised, ready to deploy, for a period of time to instantly respond upon a report of a new fire.

The NSW RFS has 27 RAFT Units across the state, with a total of about 500 personnel. The value of the NSW model is shown by the effectiveness of their teams in stopping fires becoming blazes: for instance, in the 2018/19 fire season the Rapid Aerial Response Teams responded to 77 incidents, and were able to keep 90 percent of the fires they attended contained to less than 10 hectares in size. The teams were on standby 60 times during the bush fire danger period (NSW Rural Fire Service, 2019:32).

In 2018/19, an additional 84 volunteers were trained in Remote Area Firefighting, bringing the total number of remote area firefighters to over 600! Clearly this is a significant and growing part of fire response in NSW, and one which observers feel must grow as climate change impacts fire seasons and behaviour.

The NSW RAFT Risk Analysis has a number of 'special consideration' criteria, which include

- Fire weather conditions that require special consideration include: temp>40°, RH<10%, wind > 20kph, Fire risk VH to Catastrophic.
- Fire conditions that require special consideration including: size > 20 ha, active edge > 1km, flame height > 1.5 m, Overall Fuel Hazard > High. (York & Stephens, 2011:Appendix A.).

Clearly there are limits for RAFT team operation, but these would not have been exceeded in the initial stages of a number of the fires studied.

Victoria

Forest Fire Management Victoria (FFMV) crews are made up of firefighters from the Department of Environment, Land, Water and Planning (DELWP), Parks Victoria, VicForests and Melbourne Water. The mission is to 'reduce the risk and impact of bushfires on Victoria's parks, forests and other public land'. FFMV crews also support the CFA to fight fires on private land. FFMV has a permanent workforce of career firefighters and also employs seasonal firefighters over the fire season, generally from November/December until the end of March.

About a third of Victoria is public land. Much of it is remote, mountainous and inaccessible, and fires in these areas are usually caused by lightning which, if not rapidly suppressed, can grow in size quickly. Apart from sending FFMV crews in by truck, specialist remote area firefighters may be dropped in by helicopter. DELWP currently has four seven-person rappel crews employed during the fire season which are based at Heyfield in Gippsland and Ovens in north east Victoria. It has access to a range of air support, including Large Air Tankers (LATs) and Very Large Air Tankers (VLATs), and helicopters that are able to drop water and/or fire retardants onto forested areas. It adds at least 600 additional fighters every summer to its permanent force.

In the 2019/20 fire season, FFMV crews suppressed 89% of all new ignitions with aggressive 'first attack' techniques.[3]

Tasmania

Following huge fires in Tasmania over the summer of 2018/19, an independent review was requested by the Tasmanian Government into the management of the 2018-19 bushfires by the Tasmanian fire agencies, including the Tasmania Fire Service (TFS). The review found issues with the management of some of the major fires, and made a series of recommendations for fire services and government, including a proposal to re-establish a volunteer remote area firefighter group within the TFS. Part of this recommendation was a cost benefit analysis of creating one or more remote area firefighting units based in urban areas (AFAC 2019). Another recommendation was that TFS, Tasmania Parks and Wildlife Service (PWS) and Sustainable Timber Tasmania (STT) should jointly reach a decision on whether a winch capable remote area firefighting capability should be maintained in Tasmania and which agency or agencies should be responsible for that program. So clearly there is significant attention in Tasmania to this issue.[4]

[3] Taken from The Mountain Journal. https://themountainjournal.wordpress.com/2020/04/29/a-remote-area-firefighting-force-for-victoria/

[4] It is interesting to note that the Chair of the Independent Review team was Mal Cronstedt, Deputy Commissioner from the Department of Fire and Emergency Services WA.

Figure 19 – Tasmanian remote firefighting in action

Safety of RAFT teams

WA has no Remote Area Firefighting program within FESA, the WA BFS, or Parks and Wildlife within DBCA.

Questions about RAFT teams were met with disdain in one interview with DBCA staff, who suggested that they were extremely dangerous and had led to fatalities. In a later interview this was suggested to be in regard to US RAFT teams, but even there, there does not seem to be a major problem. Wildland firefighting deaths (of all sorts) are a significant proportion of all US firefighting deaths (National Fire Data Center 2018) – above 50% in 2017 for example. But the proportion of these from RAFT-style teams is not large – no specific mention is even made of this in a review of wildland firefighter deaths (Butler et. al. 2017). In 2019, of the 48 firefighters who died while on duty in the US, none appear to have been RAFT firefighters (Fahey et al 2020). By far the most common cause of death in 2017 is stress/overexertion - 60% of the 87 deaths, followed by being hit by vehicles (16%) or in vehicle collision (11%) (National Fire Data Center 2018). Only 3 deaths were actually from being caught or trapped by fire, or by contact.

According to an Australian RAFT team member, no RAFT personal have been killed in Australia (P Zylstra pers. com). So it does seem interesting that WA has not ventured into this area of firefighting, in conjunction with water bombers, given the remoteness of much of our state.

RAFT for WA?

WA has no Remote Area Firefighting program within FESA, the WA BFS, or Parks and Wildlife within DBCA. Yet of the six fires studied, we believe a good case exists that at least two could definitely have had a RAFT team or equivalent intercede in the early stages of the fire. The fires for which this seems likely are:

- Cascade Scaddan, possibly even without aerial support, given the mild conditions and the size of the fires (from the aerial photographs);
- Bremer Bay in the very early stages, and particularly in conjunction with water bombers;

Two other fires MAY have been suitable:

- Mondurup – if the conditions on the peak were not considered too rugged for a RAFT team, and particularly in conjunction with water bombers.
- Mt Success – if the team was there very early: even by 1830 (90 minutes after DBCA was given a confirmed location) the fire was substantial in size. But according to social media the fire was first seen at 4.30pm. At this stage it would have been much smaller.

Two fires would appear to have suffered from resourcing issues:

- 0'Sullivan fire, where the lack of a bulldozer (due to breakdown) to complement the water bombers that were on site, meant that fast attack failed.
- Bremer Bay in the very early stages, where the available bulldozer was inadequate for the terrain.

It seems that the Waroona fire was probably not a good candidate for RAFT teams given the close proximity of fire 69 – what it needed was better luck.

Even with the small sample of just six fires, the development of a RAFT capacity in WA seems worth investigating. While there would clearly be significant costs associated (training, equipment, housing and helicopters) the potential savings are immense. The cost of fighting just two of these fires (Mondurup; and Mt Success) was over two million dollars[5]. And that does not cover the DFES expenditure on Mt Success.

The cost of some of the other fires far exceeds that: according to the Insurance Council of Australia, the insured losses for the Waroona bushfire were over $60 million[6]. This is in addition to losses from damage to state-owned pine plantations set to cost the WA economy up to $50 million in lost revenue[7]. And two people died, while many others had their lives shattered. The costs of the Cascade Scaddan fire were even higher, headed by the unquantifiable four fatalities. The quantifiable aspects are headlined by the agricultural losses of up to $150 million of harvest-ready crops[8], and an unknown amount of damage to farms and infrastructure.

[5] Hon STEPHEN DAWSON , Minister for Environment,
[6] According to the WA Today Website reporting state from the ICA, January 7, 2016.
[7] Laura Gartry, ABC website, "Waroona bushfire damage to pine plantations to cost WA economy up to $50m", 15 Feb 2016.
[8] According to HON DAVE GRILLS (Mining and Pastoral), WA Hansard 26 Nov 2015.

Yet the potential for better very early capacity is not part of fire reviews, other than the Coroner's Report for Cascade-Scaddan. While the DFES review of the Cascade-Scaddan fire goes into great detail about issues with interagency coordination and makes recommendations to deal with these issues, it does not discuss early attack/RAFT as a strategy. And while it does give some consideration to better resourcing for the Esperance region, especially in the early part of the season, early attack as a strategy, or better aerial capacity, are missing from the discussion. In the light of the costs associated with these fires, this is irrational and inexcusable.

So – why is RAFT not a part of the WA firefighting capacity? In the case studies, where there was no fast attack, it was not a failure of the agencies involved. In fact fast attack was employed where possible. But in a number of the fires it failed due to being incomplete (no ground attack), and this was due to the lack of resources, including a dedicated and correctly trained force. It was basically because this is not a part of WA fire-fighting strategy and capacity. This is something that needs to be addressed – and that must happen at State Government Level.

An investigation of RAFT for WA should be undertaken, in light of the potential savings.

REFERENCES

ACT Government (2011). Remote Area Fire Teams. Standard Operating Procedure 3.1.

AFAC (2019). AFAC Independent Operational Review. A review of the management of the Tasmanian fires of December 2018 – March 2019. Australasian Fire and Emergency Service Authorities Council.

Bureau of Meteorology (2016). Meteorological Aspects of the Waroona Fire January 2016, Western Australian Regional Office Bureau of Meteorology, Perth, WA. Appendix 5 in Ferguson 2016B.

Butler, C., Marsh, S., Domitrovich J.W and Helmkamp J. (2017). Wildland firefighter deaths in the United States: A comparison of existing surveillance systems. J Occup Environ Hyg. 2017 April; 14(4): 258–270.

Fahy, R.F, Petrillo J.T, and Molis J.L (2020). Firefighter Fatalities in the US – 2019. National Fire Protection Association (NFPA)

Ferguson, E (2016A). Report of the Special Inquiry into the January 2016 Waroona Fire. Waroona Fire Special Inquiry. Volume 1: Report

Ferguson, E (2016B). Report of the Special Inquiry into the January 2016 Waroona Fire. Waroona Fire Special Inquiry. Volume 2: Appendices

Linton S H (2019). Coroner's Investigation into the Esperance Bushfire, Coroner's Court of Western Australia

McCaw, L, Burrows, N, Beecham B and Rampant, B (2016). Reconstruction of the spread and behaviour of the Waroona bushfire (Perth Hills 68) 6-7 January 2016, Department of Parks and Wildlife Western Australia. Appendix 4 in Ferguson 2016B.

National Fire Data Center (2018). Firefighter Fatalities in the United States in 2017. U.S. Fire Administration, Federal Emergency Management Agency, U.S. Department of Homeland Security, and The National Fallen Firefighters Foundation

Nous Group (2015). Major Incident Review of the Lower Hotham and O'Sullivan fires, Department of Fire and Emergency Services

Nous Group (2019). Major Incident Review of the Esperance District fires, Department of Fire and Emergency Services

NSW Rural Fire Service (2019). Annual Report 2018-2019. NSW Rural Fire Service

Pacer Legal Pty Ltd (2016). Cascade Scaddan Fire Report. Cascade Scaddan Fire Review Limited.

SEMC (2015) Bushfires Review 2015 - O'Sullivan and Lower Hotham. State Emergency Management Committee.

York, S and Stephens, N (2011). Joint Operational Protocol for Remote Area Firefighting. NSW Rural Fire Service

APPENDICES

Appendix 1

5 Fires Study – Eye-witness Interview Form

Background.
The Fire and Smoke study is being funded by the Koorabup Trust, a private philanthropic trust based in Western Australia.
Five fires – Cascade-Scaddan (2015), Northcliffe (2015), Waroona-Yarloop (2016), Bremer Bay (2018-19) and Stirling Range (2019-2020) - have been chosen for a comparative study to compare the early history of each fire. These fires were all serious, and in two cases caused fatalities, and the purpose of this study is to assess if better early intervention may have affected outcomes.
A small number of eye-witnesses are being interviewed. These interviews will add details to the official accounts (which exist for the Esperance , Northcliffe and Waroona-Yarloop Fires), and are intended to help develop the timelines and events of the Stirling Range and Bremer Bay fires where no official report has been done.

Interviewer:

Eyewitness Name:
Interview Date:

Which Fire?

Are you prepared to be listed as an interviewee in the report from this study?
.....
Are you prepared to have parts of your comments quoted in the report from this study?
.....
If YES, are you prepared for us to your name put against your comments?
.....

Can you please sign to acknowledge this:
Signed: .....
Date: .....

1. What was your involvement in this fire?
   .....
   .....
2. When did you first become aware of the fire? .....
   .....
3. When do you think the fire started? (time/date) .....
4. What do you believe was the cause of the fire?
   .....
   .....
5. As you understand it, where was the ignition point location, or the first sighting location, of the fire?
   .....
   .....
6. What do you understand was the status of the fire at first sighting (size, speed etc)?
   .....
   .....
   .....
7. Do you know the first official reporting date and time?
   .....
8. Do you know who it was reported to (FESA DBCA etc.)?
   .....
   .....
   .....
9. Were there any requests (to FESA, DBCA etc) for assistance from the locals? What was asked for?
   .....
   .....

10. What was the response to these requests?
    .....
    .....
11. What was the First Response to the fire?
    .....
    .....
12. What was the trigger for the First Response?
    .....
    .....
13. What did the first response achieve?
    .....
    .....
14. Was this the same as the first official response? .....
    .....
    .....
15. If NO, what was the time of first official response? .....
16. What was the trigger for first official response?
    .....
    .....
    .....
17. What Resources were available to the first official responders?
    .....
    .....
18. Was the first official response a fast attack? .....
19. What resources would have been needed for a fast attack?
    .....

.....

20. What was threatened as fire travelled (e.g. the region, values)?
    .....
    .....
    .....
21. What happened over the course of the fire?
    .....
    .....
    .....
22. Did any areas of prescribed burning alter the fire behaviour and assisted in fire management?
    .....
    .....
    .....
23. Where were these areas?
    .....
    .....
    .....
24. What was the outcome of the fire?
    .....
    .....
    .....
25. What was the weather like when the fire started?
    .....
    .....
    .....
26. How did the weather change over the period of the fire?
    .....
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27. Do you think that early intervention would have made a difference? .....
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28. Do you have any other comments you would like to make?
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