POST INCIDENT ANALYSIS
GOLDFIELDS FIRE 13
'THE BOORABBIN FIRE'

Department of Environment and Conservation

August 2009

CONTENTS

SECTION 4 CONCLUSIONS AND SUMMARY

4.0 Summary of PIA

4.1 PIA Process

4.2 Night Time Fire Expectations

4.3 Road Blocks

4.4 Strategic Assessment of the Fire

4.5 Conclusion

SECTION 1

REVIEW PROCESS

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1.1 The Boorabbin Fire Incident

The Boorabbin fire incident commenced when the fire was reported to the Department of Environment and Conservation (DEC) emergency contact officer at Kalgoorlie about 1450 hrs on Friday 28 December 2007. The fire was formally designated 'Goldfields Fire 13' and became known as the 'Boorabbin Fire' or 'Boorabbin Incident'. The term 'incident' is derived from the Australian Interagency Incident Management System (AIIMS). The title of the fire refers to its location as it commenced in the Great Eastern Highway (GEH) road reserve and quickly moved into the Boorabbin National Park adjacent to the GEH road reserve. The Boorabbin National Park is managed by the DEC Goldfields Region (GFR) and this determined that the relevant hazard management authority (HMA) was DEC. The DEC Goldfields Region Duty Officer (RDO) assumed control of the fire supported by the DEC State Fire Duty Officer (SDO) operating from Bunbury and later from Perth. The fire soon moved out of the Boorabbin National Park into a large expanse of unallocated crown land (UCL). DEC was assisted by other emergency response agencies, local shires, infrastructure agencies, contractors and local businesses. Tragically, on the third day Sunday 30 December 2007, three truck drivers were killed when the fire enveloped them in their vehicles on the GEH.

The incident went for seventeen days from 28 December 2007 until 13 January 2008 attaining a final size of 39,500 ha when contained on 9 January. As the fire had crossed the GEH twice and threatened to possibly cross the highway a third time, it was kept closed from 31 December until the fire was safely contained on 9 January.

1.2 DEC's Response to the Incident

DEC responded to the fire as soon as it was reported and was fully engaged in combating the fire until the task was completed. An Incident Management Team (IMT) was set up at Kalgoorlie with the Operations Section at Koorarawalyee at the first opportunity on Saturday 29 December 2007 and fire fighting resources were deployed to the fire ground. The initial deployment of resources was a measured response thought to be adequately matched to the nature of the fire and was in excess of any other incident response in the GFR to that date. DEC's GFR has been undergoing a fairly recent enhancement of fire management planning and response that has evolved from a traditionally low level of capacity consequent upon the large expanse of natural vegetation containing sparce development. DEC proportionately increased the incident response in stages as the actual fire and fire potential threat increased. A substantial increase in the IMT and fire resources was organized on Sunday 30 when the fire escaped containment lines and crossed the GEH southwards. This was regarded as a major escalation of the fire requiring a commensurate augmentation of the fire management team and fire fighting resources. Tragically the fatalities occurred that Sunday evening when the fire unexpectedly returned to the GEH during night time conditions before the committed resources could arrive the following day.

The ongoing strategies to manage the incident built on those established prior to the fatalities with the notable exception that partial road blocks using escorted convoys were not employed again and the GEH remained closed for the remaining duration of the uncontained fire.

1.3 Objectives of the Review Process

The aim of this Post Incident Analysis (PIA) is to produce an analysis of Goldfields Fire 13 (Boorabbin Fire). The PIA is a record of *'what happened'*, *'why it happened'* and what can be done to *'improve the performance'* of fire suppression and incident management operations and to *'prevent a recurrence'* of the tragic outcome. The PIA process also acknowledges *'what went right'* and confirms current effective operational practices. The analysis and proposed actions from this PIA that are accepted by DEC will be confirmed as formal findings and further developed into a program of remedial action and improved operational procedures presented in a separate document titled 'Findings and Actions from Inquiries into the Boorabbin Fire 28 December 2007 – 8 January 2008'.

1.4 Fire Operational Guideline 31

Fire Operational Guideline 31 (FOG 31) After Action Reviews and Post Incident Analysis provides standard advice and a template checklist for reviewing wildfire incidents. It has provided useful guidance for the production of this PIA, but the unique character of the Boorabbin incident demands a greater emphasis on the analysis of cause and effect somewhat beyond the 'routine' fire incident and so this PIA process has been adapted to that purpose.

1.5 Review Team

The Director General of the Department of Environment and Conservation convened an Incident Response Team (IRT) to oversee the review of the Boorabbin incident, see Appendix 1 'Boorabbin Fire Incident Response Team Structure'. The Director General commissioned the IRT with instructions to comprehensively examine the incident with a view to ensuring that any necessary remedial actions are identified and implemented. The process is also required to help DEC fire fighting staff deal with the aftermath of the tragedy and support them in their future fire fighting activities. During the process a supplementary group of DEC fire managers and leaders was formed to assist the IRT with the review of emerging issues, deal with questions about DEC's incident management system (IMS), examine various technical matters and to form these deliberations into findings and actions for operational application as soon as possible. This group is titled the "Findings and Actions Coordination Group" (FACG – brief title 'Coordination Group' also know colloquially as the 'Lessons Learned Coordination Group - LLCG') and has some common membership with the IRT.

The review process is also designed to assist the Coronial Investigation and Coronial Inquest. It is hoped that DEC's detailed investigation and findings will assist others who have been affected by the incident and want to know the details of what happened. The

reports will be provided to other Government agencies for consideration and where necessary endorsement of recommendations and proposed actions.

DEC contracted GHD Pty Ltd to conduct two independent professional reviews of the fire. The GHD reports authored by Mr. Paul de Mar are titled 'Fire Development Chronology - June 2008' and 'Operational Review - July 2008'. The Chronology details the physical development of the fire from start to finish and the Operations Review looks at how the fire was managed. The contract brief required GHD to thoroughly investigate all aspects of the fire with full access to DEC staff and to all information in DEC's possession. The IRT facilitated GHD's review process to the maximum extent. GHD's reports were made available to the coronial investigation immediately on completion. DEC expects that the GHD reports will be publicly available in due course.

1.6 Review Program

The review program was not tied to a schedule but was confined by the Coronial Enquiry and coming fire season. The IRT aimed to have the DEC enquiry and investigation process completed in time to be included in the Coronial Investigation conducted by the Arson Squad and thereby available to inform the Coronial Hearing. Remedial actions or improvements to standard operating practices or guidelines for fire management would be incorporated into fire operations as soon as possible. The timeframe set for the delivery of the GHD reports was met by the contractor. The DEC enquiry and review process has been continuously undertaken in the eighteen months since the incident. Many of the operational improvements have been implemented and others are undergoing development. The Interim Guidelines for Vehicle Control Points for all agencies has been trialed at substantial fires by DEC.

1.7 Review Components

The components of the IRT's debrief, analysis and reporting process is depicted in Appendix 1. The review process commenced with the fire fighting teams doing their own detailed reviews of their fire shifts, followed by a collective review by key fire fighters from all shifts and IRT members, and a further review by the Boorabbin IMT leaders (first three shifts) with the IRT. The process and format for the reviews generally follow the procedures set out in DEC's FOG 31 After Action Reviews and Post Incident Analysis. The IRT has examined the debrief reports, identified and categorized the emerging issues and convened a Coordination Group comprising DEC staff with senior experience and expertise in fire management to confirm the PIA findings and convert them into improved operational fire management practice.

This PIA report concentrates on the first three shifts leading up to the fatalities on the Great Eastern Highway, covering Friday 28, Saturday 29 and Sunday 30 December 2007. Unless otherwise indicated, this PIA report refers to events occurring in this timeframe. However, the overall PIA process covers the whole extent of the fire and the Findings and Actions report will capture all recommendations for improvements to DEC's fire suppression operating procedures emanating from the entire Boorabbin fire experience.

1.8 Debriefs Held

FOG 31 provides guidelines for debriefs but allows for fire teams to conduct debriefs in a manner that best suits the make-up of their team and the experience they had at the incident. The extent to which groups meet as they were at the fire, or as their normal district and regional groupings is a matter of choice. The Preformed Teams (PFTs) attending the Boorabbin incident are largely drawn from individual regions and so many debriefs adopted this association for their debriefs. Such groupings combine the benefits of effective regional and district management of the debriefs with the relevance of the PFTs that attended the incident. Specialist functional groups also conducted their own debriefs with their particular perspective and role in the incident. There was also something of a hierarchy in debriefs that enabled everyone at the incident, from the fire line to the Incident Management Team to participate in a structured way that accumulated and coordinated information, observations, comments and recommendations.

The following debriefs were conducted:

- State Emergency Coordination Group (SECG) Debrief at Perth 1st April 2008
- Operations Area Management Group (OAMG) Debrief at Kalgoorlie 20 February 2008
- Gold PFT Debrief at Kensington 29 January 2008
- Black PFT and Warren Region Debrief at Manjimup commenced 9 Jan concluded 26 February 2008
- Blue PFT Debrief at Kalgoorlie 4 January 2008
- South West Region Debrief at Bunbury 7 February 2008
- Wellington District Debriefs at Harvey 8 January and Collie 6 February 2008
- Blackwood District Debrief 6 February 2008
- Swan Region Debrief at Kensington 31 January 2008
- Goldfields Region Debrief at Kalgoorlie 29 January 2008
- Collective IMTs and Operational Leaders Debrief at Kensington 8 February 2008
- IMT Leaders Debrief at FMS Kensington with IRT 7th April 2008
- DEC Radio Communications Section Debrief at Kensington 25 January 2008
- Esperance District Debrief February 2008
- Yilgarn Shire Report to Council January 2008
- Coolgardie Shire Report at Coolgardie 16 January 2008

1.9 Debrief Outputs

The debriefs were conducted at the incident site, at the home districts and regions of the staff involved and at the Kensington office of DEC's Fire Management Services (FMS). Debriefs were attended by the various levels of working teams such as fire crews with their Sector Commanders, District and Regional Managers and Fire Coordinators, the PFT units and several selected groups comprising IMT leaders and their support staff. The debriefs were run with a variety of formats suited to the particular group with many

using elements of FOG 31 as a guide. The outputs usually took the form of notes that identified issues, made comment on them and sometimes made recommendations for remedial actions or systems improvements. Photographs taken by staff at the fire in various roles and locations were discovered by this process. The debriefs are the most valuable source of direct personal knowledge of many aspects of the fire as witnessed on site, but individual accounts also need to be put in context as they may come from a limited exposure to the overall scene. The various very detailed observations help to make the bigger picture more coherent when carefully put together. It was the IRT's job to sort through the variety of accounts and inputs and to assess the merits of the many recommendations from all sources. Most debrief recommendations were endorsed by the IRT and where there were occasional conflicts of views they were resolved by the IRT by consulting appropriate fire expertise or senior DEC managers. The independent consultants, GHD, used the same debrief material but also conducted their own personal interviews with DEC staff. DEC and GHD found common agreement on all substantial matters produced through this process.

1.10 Participation

Participants in DEC debriefs are encouraged to raise and discuss any issue that they feel is pertinent. They are encouraged to do so in an environment that looks for improvements rather than 'blame', solicits everyone's input, values everyone's contribution, is open and receptive, fosters dialogue, records accurately, takes action on conclusions and provides feedback.

Fire fighting teams can comprise hundreds of people doing a wide variety of tasks and having very different exposure and experiences during the incident. It is natural then that very few, if any, have a complete picture or recall of everything that happened. People may even have different views or accounts of the same experience. It is useful to draw all of these disparate perspectives out in debriefs and form them into a synthesis that builds a complete and accurate summary of what was intended to happen, what actually happened, why it happened and what it means for future operations.

To achieve a consensus and decisive outcome from debriefs it is necessary for the process to move from the operational reporting level to an expert fire managers group review and from there to a DEC corporate decision making process. This PIA process follows that pattern.

1.11 Interactions between: Debriefs – PIA – Findings and Actions

In customary use, the term 'debrief' refers to a formal or semi formal gathering of DEC staff most of whom were involved in the incident in question but can also involve others such as district and regional managers, Fire Management Services (FMS) officers and other relevant agencies, typically FESA or service and infrastructure agency representatives. Sometimes industrial Unions attend. In this PIA the traditional use of 'debrief' applies, but is also used in a much broader sense to refer to all of the information gathering processes, consultations and enquiries that continued well after the

normal debriefs and continued throughout the preparation of the PIA. There has been considerable iteration between the normally discrete stages of the debrief – PIA and this interaction was continuous throughout 2008. An important example of these extra components of the debrief – PIA process is the preparation of formal Witness Statements for the Coronial investigation that are expected to be submitted to a Coronial Inquest. Twenty three DEC staff involved in the fire or with an overview role have prepared formal Witness Statements with the assistance of the State Solicitors Office (SSO) and guidance on requirements from the Police Arson Squad. These Witness Statements were prepared with great care by each individual, mindful of the need to accurately recall the facts of their participation in the fire. With the approval of the Arson Squad, the State SSO and the individual authors, the Witness Statements have been very useful input into DEC's debrief – PIA process.

Over the course of many formal meetings and virtually continuous enquiry, review and analysis during 2008, the IRT and FACG believe they have conscientiously examined every aspect of the information about the fire known to DEC staff. The whole process has been conducted in keeping with the instruction of the Director General of DEC that the procedure must be objective, thorough, complete and effective so any deficiencies are remedied and a repetition of the incident avoided. DEC acknowledges that despite the path laid out by FOG 31 and long experience of post fire reviews and countless incidents providing vast experience, the Boorabbin post incident review process is unique and ground breaking. Its scope goes well beyond the usual internal review of the mechanics of fire fighting and in doing so reveals some systemic strengths and weaknesses of DEC's IMS and some vital interagency arrangements in the unusual context of a Goldfields Region fire. The conduct of the post incident review processes themselves are already a very significant outcome.

1.12 Issues Raised

The following list of items arose from the debriefs and further examination of the incident by the IRT and FACG. They became the subject matter for the PIA.

Fire Management Background in the Goldfields Region
- Fire Management History in the Goldfields Region

Fire Preparedness
- Wildfire Threat Analysis & Fire Prevention Plan
- Incident Preparedness and Response Plan
- Fire Personnel Availability in Remote Regions
- Contractor Resource Availability

Initial Fire Response
- Fire Detection and Notification
- Fire Cause Investigation

Fire Assessment and Appreciation
- Declaring Wildfire Levels
- Strategic Appreciation of the Fire
- Fire Behaviour Prediction

- Adequacy of Resources Allocated
- Preformed Team Dispatch Criteria
- Fire Resources Support for Remote Regions

Fire Strategy and Operations
- Fire Suppression Strategies and Tactics
- Operations Point
- Incident Control Centre
- Fire Operational Guidelines

Special Constraints in the Goldfields Region
- Travel Distance Times to Remote Regions
- Use of Aircraft
- Use and Availability of Water in Remote Region Fire Suppression
- Vulnerability of Tyres
- Communications in Remote Regions

Fire Weather
- Weather Forecasts

The Incident Management System
- Incident Action Plans
- Fire Maps

Managing Road Traffic
- Traffic Management

Interagency Operations
- Agencies at the Fire

Public Information
- Information Provided to the Public

Qualifications of Staff'
- Staff Qualifications and Experience

Safety
- Safety Considerations at the Fire
- The Management of Fatigue

Training
- Staff Training Before and After the Fire

Critical Incident Management and Staff Welfare
- Critical Incident Review Process

1.13 Independent Review

To ensure objectivity and to gain the assistance of additional professional expertise, DEC tendered a contract for a Chronological Review and an Operational Review of the incident. GHD Pty Ltd was awarded the contract, with the principal consultant being Mr. Paul de Mar. The consultants were eminently qualified for the task and the individual consultant officers are recognized nationally for their bushfire expertise. The terms of reference for the two studies are detailed and comprehensive and fully enabled GHD's independence and objectivity in making enquiries. The terms of reference are attached as Appendix 2.

GHD staff were given all of the assistance they required by DEC, including examination of the fire ground, access to all staff for interviews, a complete copy of all documentation, satellite imagery, regular consultation with senior DEC staff and fire specialists, participation in DEC's debrief and PIA processes. GHD also talked to the Arson Squad and the Bureau of Meteorology (BOM). The consultants did not have access to the many other witnesses that have been involved in the coronial enquiry and are not employees of DEC, thus the information available to GHD was sourced from DEC or produced from their own studies. One exception was a report on the weather at the fire produced by BOM.

The contract brief for the Operations Review includes a request for comment and advice on any aspect of DEC's standard operating procedures and fire operations guidelines that might be modified and improved by the lessons learned at GFR fire 13. DEC has also sought informal advice from fire managers that have had similar experiences in Australia's recent spate of severe wildfires. All advice sought has been valued for its expertise, objectivity and independence.

GHD produced the Fire Development Chronology report in June 2008 and the Fire Operational Review report in July 2008 and these were immediately forwarded to the Arson Squad to assist the Coronial investigation. DEC suggests that the GHD Fire Chronology will be the definitive technical account of the physical behaviour of the Boorabbin fire and should provide a common factual resource document for all enquiries. More specific forensic information of how the fire affected travelers on the Great Eastern Highway is likely to be an outcome of the Coronial investigation. It is also likely that other accounts of fire behaviour and fire imagery captured on cameras will be forthcoming through the Coronial investigation and these may be put in context by reference to the technical character of the GHD Fire Chronology report.

The GHD Operational Review report is also an objective and technical study structured around the AIIMS process and DEC's IMS and Standard Operational Procedures (SOPs) and interpreted through the professional experience and judgment of the consultants. It focuses on the fire management systems that DEC employs and how they compare with others used in Australia, and to some extent, overseas. The report also considers how effectively the systems were applied at the incident and identifies areas where there were deficiencies and what remedies or improvements might be adopted. Of necessity there is an element of professional judgment exercised by the consultants in drawing conclusions about the performance of IMS functions at the incident, but they explain their reasons for their views with reference to accepted SOPs and current best practice within Australia.

DEC has studied the GHD reports and has no substantial disagreement with the contents and accepts the substance of the recommendations. Any points of difference are relatively minor or are within the discretionary range of the recommendations. DEC's PIA process, running simultaneously with the GHD studies, has independently arrived at many of the same conclusions as GHD, but acknowledges some novel insights by the consultants.
A detailed response by DEC to the GHD reports has been forwarded to the Arson Squad for the Coroner's information. The response covers the factual conclusions of the reports,

the recommendations for improvements to DEC fire SOPs and a statement of conclusions about the contributing factors and causes of the main outcomes of the Boorabbin fire. A sequel to this initial response to the GHD reports takes the form of a 'lessons learned' report (the Findings and Actions report) that will encompass the independent consultants recommendations and those produced by DEC's own enquiries.

Note: The term **Standard Operational Procedure (SOP)** has a broad meaning in this PIA. It includes all written fire guidelines (e.g. Fire Oerational Guidelines – FOGs), manuals, systems, tables, guidelines and procedures and also those practices (not necessarily documented) that are accepted as correct conventional and standard practice for fire management and fire suppression within DEC. The terms of reference for the GHD reports includes a request to compare the management of the Boorabbin incident with DEC's Standard Operating Procedures and also those generally accepted in Australia, particularly the Australian Inter-service Incident Management System (AIIMS). The senior staff of DEC's Fire Management Services Branch are best placed to 'rule' on what is a SOP and what is not 'standard'.

1.14 Stakeholders

Stakeholders participating in a DEC PIA can include the fire combat forces and other agencies and organisations involved in the fire, depending on the circumstances. The Boorabbin fire involved DEC, Fire and Emergency Services (FESA), Western Australia Police (WAPOL), Main Roads Western Australia (MRWA) and their contractors Macmahon Holdings Ltd, utility organizations such as Western Power (WP), Telstra, Water Corporation, the Shires of Coolgardie, Yilgarn, City of Kalgoorlie-Boulder, private contractors providing machinery and services, landholders and businesses, and members of the traveling public and transport industry particularly those using the Great Eastern Highway at the time. As most of these stakeholders are contributing to a coronial investigation process undertaken by the Police Arson Squad it is appropriate in these circumstances that the DEC PIA focuses only on DEC staff in the pre Coronial Inquest phase. After the Coronial Inquest the PIA and Lessons Learned reports will be augmented by the findings of the Coroner and any other testimony pertinent to future fire management. It is envisaged that some of these initiatives will be undertaken with other parties and agencies. The Guideline for the Operation of Road Closures During Bushfires (as at 07/01/09 - also called the Vehicle Control Point (VCP) Guideline) produced by WAPOL in consultation with DEC, FESA, MRWA and Shire representatives is an example of a combined agency initiative.

As previously mentioned, the two GHD reviews are likewise primarily based on information gained from DEC staff and information available to DEC and were not able to access the many other stakeholders involved in the fire.

SECTION 2

DESCRIPTION OF THE FIRE

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2.1 Sources of Information

Sources of information for this PIA of the fire are mostly drawn from information in the DEC debriefs, discussions with the Incident Management Team (IMT) staff, study of documents produced at the fire, and DEC staff statements to the police. Only a small amount of factual information has been drawn from the GHD studies as they progressed in parallel with the DEC PIA. DEC contributed remote sensing information and other documents to GHD that has informed the reconstruction of the fire but has left the technical analysis, interpretation and presentation of that information to GHD. The PIA process has been conducted independently of any other inquiry to maintain objectivity and ensure the findings are entirely DEC's. The Findings and Action report prepared by DEC integrates the information available from the PIA and GHD reports, reconciles the reports, reaches conclusions and makes commitments to appropriate actions. The PIA and GHD reports turned out to be in substantial agreement, enabling the integration of their conclusions and recommendations. In view of the very comprehensive graphical depictions of the fire and the containment operation in the GHD reports, this PIA is mostly presented in text form and should be read in conjunction with the GHD reports and DEC's summary document, the Findings and Actions report. Several maps of the fire drawn from the GHD reports are attached as appendices to assist the interpretion of the PIA.

2.2 Fire Overview Thursday 28 December 2007

2.2.1 Fire Commencement

The Boorabbin Fire commenced during the afternoon on Friday 28 December 2007 in an informal traffic parking area on the north side of the Great Eastern Highway near the old Duri townsite 104 km west of Coolgardie and 84 km east of Southern Cross. The site is also 74 km west of Bullabulling and 50.5 km east of Yellowdine. The Koorarawalyee (Koora) Anglican Church Bushland Retreat is 15 km to the west of the ignition site. The fire started on land vested in MRWA as a road reserve and moved north into the immediately adjoining Boorabbin National Park managed by DEC. DEC therefore became the HMA.

2.2.2 Cause of the Fire

DEC formally investigated the cause of the fire at 0930 hrs on 30 December. The site had been subject to fire suppression activity prior to the investigation. The investigation findings are documented in a Wildfire Cause Investigation Report. The DEC investigator located the origin of the fire to within a 2m x 2m area adjacent to the eastern edge of the cleared parking area. The fire commenced in sand plain heath containing Allocasuarina, Callitris and Eucalyptus on the edge of the cleared parking area and escaped to the north

into continuous highly flammable vegetation. In the prevailing weather it quickly escalated beyond the control of anyone not in possession of fire fighting equipment.
Despite finding the ignition point, no actual source or cause of ignition was discovered. Causes such as lightning, powerlines, self-ignition were considered and disqualified, leaving human caused ignitions, either accidental or deliberate, as the most likely explanation. However, as no evidence of human intervention was found the report declared the cause to be *'undetermined'*.

The DEC investigator accompanied the Arson Squad to the ignition site on 31 December to assist their inspection. The result of the Arson Squad's investigation has not been formally revealed to DEC as yet.

2.2.3 Fire Reported

The fire was reported to DEC's Regional Duty officer in the Kalgoorlie office through a phone call to an officer's mobile phone at approximately 1450 hrs on Friday 28 December by a resident of Koora, Anna Killigrew who could see the column of smoke and placed the fire east of Koora. At around 1515 hrs the Fire and Emergency Services (FESA) Communications Centre in Perth reported the fire to the DEC Regional Duty Officer, describing its location as the Boorabbin National Park. Shortly afterwards, Anna Killigrew called again to say the fire was located in a truck bay near the 414 km peg on the Kalgoorlie water supply pipeline; this information imparted to her by another Koora resident, Peter Harrison who had gone to investigate the fire.

2.2.4 Initial Fire Assessment and Response

On receiving notification of the fire, the Regional Duty Officer immediately assumed the role of Incident Controller (IC), plotted the reported current location and the anticipated direction of run of the fire on a map and dispatched two available DEC officers in a light fire fighting unit to investigate the fire. At 1550 hrs the IC phoned the Kalgoorlie police to inform them of the threat of smoke on the GEH and requested police attend to manage traffic.

The IC also considered the fire suppression resources he might need and at 1610 hrs phoned a local machinery contractor (Hampton) seeking machines for fire break construction. The IC was aware that if the fire escaped initial containment it would require a sustained effort of fire containment line construction to pursue the fire. With the consent of the IC, the machinery contractor agreed to supply the equipment the next morning due to the difficulties of night time transportation.

At 1615 hrs the IC participated in the routine daily afternoon telephone conference of DEC duty officers (DO) throughout the State, coordinated and hosted by the State Operations Officer (SOO) who assists the State Duty Officer. At that time both were located in Bunbury. The IC requested additional support to suppress what he was expecting to be an ongoing uncontrolled fire at Boorabbin. The request was immediately supported and arrangements made to dispatch five heavy duty fire trucks, four light fire

units and a front end loader to the fire and incident management support staff to the Kalgoorlie office, sourced from DECs adjoining Wheatbelt Region and also from the Swan Region. The resources were mobilized overnight with rest destinations on the way at Southern Cross and Merredin so they would arrive as early as possible at the fire the next day. An Incident Management Team, mostly drawn from the State rostered Preformed Team, was organized to fly into Kalgoorlie by chartered aircraft the next morning from Bunbury.

At 1700 hrs the IC received a phone call from a Shire of Coolgardie Officer saying that the fire was escalating into the Boorabbin National Park. At approximately 1800 hrs the two DEC officers arrived at the origin of the fire on the GEH and informed the IC that the fire had a flame height of four to five metres and a forward rate of spread of 1 – 2 kilometres per hour driven by southerly wind of 15 to 20 kph, gusting from 25 to 30 kph, and appeared to have progressed one to two kilometres past the pipeline to the north. It was obvious to the DEC reconnaissance officers and the IC that in the absence of fire suppression resources and considering the extent and behaviour of the fire, no useful suppression work could be undertaken until the next day. The IC and field staff finished work at 2300 hrs as no further useful work could be done. The reconnaissance staff at the fire stayed overnight at Koora as they had the agreement of the Retreat owners that it could be used as the Operations Point (OP) for controlling field operations.

2.2.5 Fire Development

At 2015 hrs on Friday 28 December the DEC reconnaissance officers checked the progress of the fire by driving along the 220 kva powerline and reported the fire approaching that point with the fire behaviour slowing down but still active. There was no fire projection modeling done as the Incident Management Team (IMT) was not yet in place and the full extent of the fire overnight was not exactly determined on 28 December.

2.2.6 The post incident analysis done by GHD as a fire chronology (Fire Development Chronology June 2008) describes the fire at midnight as extending 17.5 km north of the GEH and covering some 2219 hectares with a perimeter in excess of 40 km.

2.3 Preparation for Fire Suppression for 29 December 2007

The main preparation on Friday 28 for the commencement of active fire suppression on Saturday 29 December was the organization and preparation of fire fighting resources and IMT staff for deployment the next day. Some crews were able to make a start on Friday with an overnight stop on the way. Individual officers made their own preparations for their roles anticipating what they would need for their functions at the Incident Control Centre (ICC) or Operations Point. As the Department had no other fire commitments these preparations were not limited by available resources, although there was an awareness that the weather conditions throughout the south of the State were hazardous and the holiday period would constrain the availability of resources from other organizations.

2.4 Fire Overview 29 December 2007

2.4.1 Fire Suppression Organisation

On the morning of 29 December the following deployment occurred:

The IMT at the ICC at DEC Kalgoorlie office:

- IC resuming from 28 December
- Planning Officer (PO)
- Situation Officer (SO)
- Resources Unit Leader
- Resources Unit Assistant
- Logistics Officer (LO)
- 2 Management Support
- 1 Finance Officer
- Ground Support Officer
- 3 Runners
- 2 IT Support

At the OP at Koora:

- Operations Officer (OO)
- Staging Area Manager
- Air Operations Leader/Air Observer (AO)
- Koora Retreat Staff volunteers

Facilities at the OP

- Mains power
- Parking and staging area
- Operations Tent
- Koora donga units
- Land line telephone
- Mobile phones
- VHF radio – limited range/simplex
- HF radio – limited number of units
- Satellite phones
- Laptop computers
- FESA mobile VHF repeater trailer
- Whiteboard
- Maps

On the Fire Ground

Sector A

- 1 Sector Commander (SC)
- 1 Light Unit
- 1 DEC Front End Loader (FEL)
- 1 Float

1 Crew

Sector B

1 Sector Commander
1 Light Unit
1 Heavy Duty Fire Tanker
1 Crew

Sector C

1 Sector Commander
1 FESA Liaison Officer
1 Light Unit
2 Heavy Duty Fire Tankers
3 Crews
1 Wheeled Dozer (G Wilson contractor)
1 Grader 12G (Hampton)
1 FEL 988 (Hampton)

Landing Ground

1 Helicopter

2.4.2 Fire Assessment and Planning

The fire was divided into sectors; sector A being the eastern flank of its south to north edge and Sector B being the parallel western edge. The strategy was to conduct a direct attack on the flank fires and to catch up with the head fire when it was slowed or halted by running into low fuel areas. This needed to be achieved whilst the southerly winds continued to push the fire away from the GEH on the northern side. A wind change coming from the northerly sector on the following day would threaten this strategy, especially as the forecast conditions were for a 'blow up' day. A 'blow-up' fire weather alert from BOM warns of extreme fire weather with hot and very windy conditions, typically temperatures in excess of 35^0C and wind speeds greater than 50km/h.These conditions would put pressure on the flank containment lines that must be held to prevent the fire running south and across the GEH. Despite the severe conditions, the IMT was reasonably optimistic that their objective could be achieved.

In practice the strategy had to be modified when it was discovered that there was an unexpected tongue of fire emanating from near the point of origin of the fire and running north west. This contingency compromised their strategy by making sector B redundant and so sector C was created on the south side of this run of fire, placing a critical defensive fire containment line between the fire and the GEH.

The Incident Action Plan (IAP) prepared at 1300 hrs on Saturday 29 for the operational period 0800 to 2100 hrs Saturday 29 stated that the General Operational Strategies and Tactics were: *"direct attack on active western edge of fire using wheeled dozer and heavy duties. Construct mineral earth break on eastern boundary of fire."*
The IAP prepared at 1500 hrs on Saturday 29 for Sunday 30 0800hrs to 2100hrs elaborated on the previous version as follows: *'Direct attack of fire along southern, western and eastern boundary, establish and consolidate containment lines. Working*

northwards from the GEHwy to Merbine Track. Tie fire into 2000 fire scar and woodlands to the west. Forcast (sic) trough movement predicted at 11am strong northerly winds – attention on blackout along southern boundary of Charlie Sector and on Alpha sector.'
[PIA note: The *"2000 fire scar"* was actually the 1998 Boorabbin (Gilgai) fire.]

This strategy was favoured because it was considered to be the safest plan for fire fighters, would be cost effective and efficient, would contain the fire to the smallest possible area and would protect assets. Two other strategies were considered. One was to mount an indirect attack on the western boundary using the Merbine track linked to old fire scars and backburning to consolidate the Merbine track defensive line. A mineral earth break would secure the eastern boundary. This strategy was thought to be more dangerous for firefighters and would put assets at risk. The third strategy was to allow the fire to burn out the entire sandplain vegetation type with the GEHwy forming the southern boundary. This would mean all fire fighting forces would form a defensive line along the GEHwy. This strategy was not favoured because it may cause issues on the GEHwy would cause an entire vegetation type to burn out and would put assests at risk.

2.4.3 Fire Suppression Operations

A direct attack on the flank fire edges on sectors A and C was executed as this provided safe refuge for crews in the burnt ground if needed. Each attack unit consisted of a front end loader to clear a fire break track supported by two fire tankers. Difficulties encountered included a convoluted boundary where the fire edge was variable and staking of truck tyres by severed vegetation. Water supplies on the fireline were limited despite the presence of the Goldfields pipeline and a nearby scheme water storage tank. A hired water tanker stationed near the origin of the fire on the GEH replenished the fire trucks.

The operation was ably supported by an Air Observer in a helicopter that was also used by the Operations Officer to gain a first hand appreciation of the fire and map its location and shape.

Communications were adequate via mobile and land line telephone but there was no permanent VHF network in the GFR. A portable FESA VHF repeater was set up on the morning of 29 December. The ICC could not receive VHF radio but could hear the few GFR HF units. The AO had to conduct SAR by mobile phone. The incomplete coverage of VHF radio over the fire ground continuted to be a problem for the duration of the fire.

Physical conditions at the Koora OP were taxing as staff worked from an open tent amongst heat, dust and flies. The owners of the Koora Bushland Retreat were very supportive.

The safety of fire fighters was a prime consideration of the OO, IC and IMT and comprehensive briefings were given to incoming crews highlighting assets, hazards and strategies.

Despite the difficulties, substantial progress was made on fire line construction on both sectors. At the end of the day 8 km of fire line had been constructed, leaving only about 2 km remaining to be done on the critical sector C to join with a low fuel fire 'scar' (previous fire (January 1998) area with diminished 9 year old natural fuels) to the west.

2.4.4 Fire Outcome (Saturday 29 December)

At the end of daylight on 29 December the IMT was aware of the satisfactory progress made on fire containment line construction and determined that the prime objective would be the completion of sector C early the next day. They calculated that 8km (straight line) of sector C had been completed with 2km (in a straight line) left to go. The actual length of fire containment line was probably a couple of kilometres more due to the highly convoluted shape that followed the fire edge.

2.4.5 Overnight (Saturday 29 December)

It was recognized that it was not possible to fight the fire in darkness as the fire edge largely self extinguished and could not be detected, presenting the risk of excluding burnt material outside of the fire containment line. The fire was therefore a dayshift operation only, including the IMT functions. Resting crews overnight was a priority for longer term fatigue management and to ensure the daylight effort was maximized. The limited capacity for resting key staff at Koora was used for machine operators and some Sector Commanders, the others travelled the 158 km to Kalgoorlie where quality rest could be assured. The travel time to Kalgoorlie when added to the decision to have an eight hour rest period could potentially encroach on daylight operational time at the fire. This was a trade-off the IMT thought appropriate especially considering the enervating fireground conditions.

2.4.6 Prognosis for Sunday 30 December

The weather forecast for Sunday 30 December was forbidding with very high temperatures and strong winds backing around from the north to the south west (see BOM forecasts attached as Appendix 3). The forecast fire danger rating was 'extreme'; conditions that are described by fire fighters as a 'blow-up' day. The IMT knew that their strategy of containing the fire to the north of the GEH would be in jeopardy and dependent on completing and holding the containment line on sector C against the northerly winds until the wind backed around to the south west and blew the fire back on itself. It was expected that the winds would resume intense fire behavior about 1000 hrs. Whilst realistic about the severity of the conditions, they were still optimistic that they could achieve their objective given the fire line production capacity demonstrated on Saturday and the proximity of lower fuels in the 1998 fire scar near sector C. However discussions recognized the contingencies of closing the highway, safety issues connected with pursuit of the fire and the need to reassess strategies should the fire break out. An IAP was prepared documenting the strategy and contingent operational functions. A map of the known location and extent of the fire was produced but did not extend to a

projection of the fire run should it break through containment lines. Crews were organized to commence at 0600 hrs in the morning at the OP and about 0630 on sector C.

The forecast was:
Max temp 44^0
RH 5%
Morning winds 35kph NNE gusts to 70kph
NW at 25kph until 1500 hrs
SW at 32kph after 1500 hrs

2.4.7 The GHD Chronology shows that by the end of Saturday 29 the fire had run 17.5 km at its most northerly point with a widening of the lower south west flank by 3 km as the wind backed around from southerly to easterly and an unexpected narrow tongue of fire stretching 9 km from the heel of the fire to the north west (Sector C). This tongue being particularly problematic as it was on the GEH at its eastern most point and only 3.5 km from the GEH at its most westerly point, with the prospect of strong northerly winds pushing it towards the GEH on Sunday 30. At this stage the fire had burnt 4169 hectares. The fire crews had achieved 12 km of fire containment line on the eastern flank (Sector A) and 7.5 km on the south west flank (Sector C).

2.5 Fire Overview Sunday 30 December 2007

2.5.1 Fire Suppression Assessment and Planning

At 0830 hrs on Sunday 30 December the IMT reviewed the strategies in the IAP. Extreme fire behaviour was identified as a key issue in the fire suppression strategy. The forecast indicated strong hot northerly winds gusting to 70 kph. The IAP prepared on Saturday 29 was confirmed as still valid but contingency plans for managing a breakout of the fire across the GEH involved contacting Macmahon Contractors (contracted to MRWA for road work services) and the police to warn of the possible need for road blocks. Notification to other asset authorities and the news media was also in readiness. Operations Section prepared plans to evacuate and protect crews and equipment should the fire escape containment lines and cross the highway. In discussions between the OO and PO it was decided that if the fire escaped the sector C containment line the intention was to only observe the fire run to the south of the GEH and concentrate on protecting and managing the assets in the highway zone, but as a precaution the OO asked for a dozer for scrub rolling should the fire cross the GEH. Another contingency action adopted by the OO involved using the grader to clean up an existing track as a secondary containment line around the fire scar and as a timely safe access onto or off the sector.

The IAP prepared at 1400hrs on Saturday was not amended or updated to provide a formal documented contingency plan for the escape of the fire from sector C. Whilst aware of the possibility of a fire breakout, the IMT was intent on containing the fire along sector C with an early completion of the containment line and were reasonably hopeful of success

2.5.2 Fire Development North of the GEH on Sunday 30 December

Suppression operations commenced with a briefing by the OO listing the assets for protection, including the GEH, and the hazards and safety precautions emphasized. At 0615 the rubber tyred dozer and heavy duty fire tanker departed for work on sector C. The 980 front end loader needed mechanical attention and became operational at 0827 hrs. Crews were dispatched between 0615 hrs and 0630 hrs. The sector A operation was to be mop up and patrol. Track construction work south of sector C was tasked to provide for access to the containment line, an escape route for crews and a potential fall back position should the main containment line on sector C be breached. A grader was used to improve tracks.

The sector A Commander reported that sector was quiet and under control. Sector C commander confirmed commencement of track work at 0720 hrs.

The OO worked with insufficient support staff at the OP between 0600 hrs and 1100 hrs.

A hop over on sector C was reported at 0907 hrs but was quickly contained. Careful attention was paid to the safety of machine operators when fire trucks had to refill with water.

At 0923 hrs the helicopter arrived at the OP and was dispatched to inspect the fire for any problem areas.

At 0930 hrs the crews that had been overnight at Kalgoorlie arrived with copies of the IAP and were briefed on assets, hazards, safety and strategy by the OO. They departed for the fire after collecting spare tyres.

At 1030 hrs a forecast arrived at the OP by email, but was a general district forecast not a spot forecast, so it did not change the previous knowledge of the impending weather. A check from the OP to the ICC indicated that the SW wind change was expected at 2100 hrs.

Punctured truck tyres continued to be a significant problem that would be alleviated when a supply of spares dispatched by the Logistics Officer (LO) arrived at the OP.

Specialist communications staff attempted to fix the OO's email connections and fix computer and VHF repeater overheating problems. The air temperature at the OP was above 40^0 for eight hours on this day and at times above 43^0 making working conditions very difficult for people and equipment. Swarms of flies added to the discomfort.

At about 1100 hrs the DEC FEL broke down and repairs were organized. All fire trucks including the light units were moved onto sector C as the priority objective.

At approximately 1100 hrs the helicopter reported a hopover on sector C, and shortly after other hop overs occurred. The fire escapes escalated running south and were out of control. Crews were ordered by the OO to exercise the escape plan to avoid entrapment.

The fire breached the nine year old fire scar in its path at its narrowest point enabling it to approach and cross the GEH. . At 1146 hrs the helicopter reported the fire had crossed the GEH running at an estimated rate of spread of 3 - 5 kph. Pursuit of the fire was not an option due to the intensity of fire behaviour with very high rates of spread and long flame lengths. Fallen power poles were recognized as a significant hazard for firefighters. See map of the fire escape at Appendix 4 Figure 1 attached.

2.5.3 Fire Development South of the GEH Sunday 30 December

The AO in the helicopter monitored the fire's progress south of the highway. At the same time the IC was also airborne witnessing the breakout of the fire. It was recognised that fire behaviour was too severe for safe suppression activity and so crews withdrew to safe locations. The headfire was reported by the AO to be spreading at about 4.5 kph. The IC also airborne at the fire in a fixed wing aircraft noted the same fire behaviour.

Some work was done by a FEL on the eastern side of the fire clearing around power poles to protect them. The microwave tower was also inspected for fire security.

2.5.4 Management of the GEH

Early on Sunday 30 the OO anticipated the possibility of the fire escaping and threatening the GEH and directed that a second set of warning signs be placed on the GEH in accordance with DEC FOG 64. The signs were emplaced at 0900 hrs.

At approximately 1000 hrs the IC phoned Macmahon warning that there was some risk of the fire escaping control measures and crossing the GEH triggering a need for road blocks.

Discussions had occurred with police during the morning concerning the potential of the fire to compromise the GEH, and thus police officers were available to set up roadblocks as soon as the fire breakout was detected. Two road blocks were established by the police with the assistance of DEC staff providing communications with the OP as direct phone contact with the police was ineffective. The western road block was located 600 metres to the west of the OP at a roadside parking area and the eastern road block placed at the intersection of the Merbine Track and GEH with a FESA officer undertaking liaison.

The OO advised the IMT that the GEH was to be closed with police road blocks. Following his inspection flight the IC formed the view that the road blocks should be withdrawn further away from the fire to Bullabulling and Yellowdine as the taffic accumulations were becoming too great to manage. The OO had also formed that view and had requested the IMT move the police road blocks further away from the fire as he did not regard them as fully formed road blocks. The OO envisaged structured road blocks resourced by contractors supporting the police Discussions between the IC and OO resolved to move the road blocks further away from the fire, to Yellowdine in the west and Bullabulling in the east. Macmahon confirmed the Coolgardie roadblock was in place at 1545hrs and the police roadblock at Yellowdine was installed between 1700 hrs

and 1800 hrs. Some residual groups of traffic remained at Bullabulling and the original road block just east of Koora. The road block at Coolgardie was staffed by Macmahon who said they could not staff the western road block and so that was left to the police supported by DEC staff. The collection of vehicles already stopped at Bullabulling was controlled by police. Traffic stopped at the eastern road block suffered trying conditions but had access to facilities in Coolgardie, but those on the western roadblock were stopped in worse conditions with a very hot, dusty and fly infested environment with few facilities, and therefore people were becoming increasingly discomforted and distressed. The police and DEC staff experiencing these circumstances at the western road block sought information and a decision from the OO regarding the future of the road block and the management of the growing traffic and travellers problems. Two police officers had to take an alleged traffic offender to the Southern Cross police station and this reduced those available for maintaining the road blocks. This situation prevailed for several hours, with traffic and travellers discomfort and frustration mounting.

At approximately 1230 hrs the Air Observer in the helicopter noted the head fire was about 2.2 km to the south of the GEH spreading at a rate of 4.5 kph and fire behavior immediately adjacent to the GEH had moderated providing an opportunity for traffic to safely pass through the fire zone under police and DEC escort and surveillance from the air. This information was passed to the OO and subsequently traffic was released from a group of vehicles accumulated immediately to the east of the fire on the GEH.

Burning power poles along the GEH were assessed for danger to traffic before any convoys were authorised.

A west to east convoy of about 50 vehicles was approved by the OO between 1400 hrs and 1500 hrs when a lull in fire behavior permitted. This convoy was escorted front and back by DEC fire trucks with a DEC vehicle in the middle. The purpose of this convoy was to alleviate the traffic accumulations and discomfort and inconvenience travelers were experiencing, provided it was safe to do so. A further east – west convoy occured later in the day followed by several large convoys from west to east. The favoring of west to east convoys because of their more taxing circumstances exacerbated pressure from those held at the eastern road block. When the small accumulation of vehicles blocked at the eastern end of the fire had been escorted through the fire zone the road block was withdrawn to Bullabulling and Coolgardie.

During the afternoon the OO saw the release of traffic through the road block from the west as a relief measure for those already accumulated at the roadblock near Koora, but wanted the source of this traffic blocked further to the west to stem the flow, and put this view to the IMT. It seems that limited resources available from Macmahon and the police prevented this option occurring until about 1700 hrs -1800 hrs when the police moved the roadblock to Yellowdine without the support of MRWA contractors.

Another DEC escorted convoy from west to east was approved about 1500 hrs whilst the OO and AO kept watch from the helicopter. The OO was replaced in the helicopter by his supporting officer in company with the AO and under their surveillance further convoys

were escorted successfully through the fire zone. Although fire behavior remained mild, some local flare ups were doused by the accompanying DEC fire trucks to reassure drivers. All DEC staff involved thought the convoy conditions posed no threat to the traffic from fire behaviour provided the traffic was only going one way each time as there was a risk of vehicles colliding in these conditions.

At 1830 hrs the OO asked the AO to conduct another thorough inspection of the fire in the helicopter to determine if vehicle convoys could proceed. At 1850 hrs the helicopter crew mapped the southern half of the fire for the IMT and at 1915 hrs reported the fire behavior to the OO. The fire behavior was described as having reduced considerably, flame heights generally about 0.5 m, some flare ups on the SE flank about 7km from the GEH, with the head fire run obstructed by woodlands and salt lakes. Winds were becoming westerly. The helicopter crew indicated they needed to depart the fire area about 1900 hrs for last light at Kalgoorlie airstrip at 2028 hrs. The helicopter landed at Kalgoorlie airstrip at 2000hrs.

At about 1900 hrs the IC at Kalgoorlie, conferred with the OO at the OP about opening the highway, particularly from the Coolgardie road block end. The OO expressed some reticence about the opening of the highway in view of the still active fire, the weather forecast and the limited road block resources. However, after some discussion of the expected fire behaviour and discussing options such as moving the formal road blocks closer to the fire to reduce response and travel times, and putting sentinels in place on the highway (the OO's suggestion) it was decided to proceed with convoys. The risk management concept was that considering Macmahon's constraints and the limited resources of the police, DEC would place staff near both ends of the fire to act in the dual role of sentinels watching fire behaviour and as sentries for consequent traffic management, one person at each end doing both functions. In the unlikely event that the fire should escalate, the sentries would stop traffic just before they entered the fire affected zone. It was expected that this measure would compensate for the absence of the Air Observer in the helicopter that had effectively guided convoys during the more severe conditions that afternoon. In debriefs the OO commented that he had expressed the view at the time of these discussions that he would prefer a complete road block, but acquiesced after receiving reports on current fire behaviour from the helicopter at 1900 hrs and also from staff on the highway that indicated mild and declining fire activity. This fire behaviour accorded with the IMT's expectations and experience on the previous two nights. The primary determinants of the strategy were the expected mild fire behaviour and the ability of sentinel/sentries to see any fire escalation and to stop the traffic accordingly. The strategy was also shared at 1920 hrs with the FESA officer and DEC's officer who were to be the sentries and the police officer on the roadblock. The FESA officer was asked by the OO to make a note of the decision in his (the OO's) diary and this was countersigned by the OO. The diary entry reads as follows: *"1926 hrs: In consultation with Terry Little, Alan Kietzman, Paul Blechynden, Southern Cross Police (Mason Ball) & IMT Kalgoorlie, agreed to open hyw in both directions – from (with reservations) Yellowdine (about 12 vehicles) & Coolgardie (about 200 vehicles). Highway will be monitored by Terry Little & Alan Kietzman at hot spots & or areas of*

concern – these areas will be monitored until all danger to public has passed & in agreeance with Terry Little, Alan Kietzman & Ops Paul Blechynden."

The final decision was to allow both the Yellowdine and Coolgardie road blocks to open simultaneously as the different distances to the fire zone would prevent them meeting where smoke might create a crash risk. The small group of vehicles still held at Bullabulling would be escorted by the police in attendance there, who would then return east to escort the arriving Coolgardie contingent. All convoys would have to pass the sentries, comprising a FESA officer at the eastern end and a DEC officer at the western end who took up their positions about 1940 hrs.

The SW wind change was expected by the IMT at 2100 hrs as indicated in the general forecast conditions (box headed 'Forecast Conditions') in the Spot Forecast, having overlooked the Significant Wind Change information in the box with that heading further down the page that said it would arrive between 1900 - 2000 hrs, preceded by a lull in the wind. The supposed 'window' of opportunity for moving traffic before the south west wind change did not figure prominently in the IMT's road block strategy as their general expectation was that fire behavior would continue its customary moderation overnight despite a wind change. Should there be any flare up, locally or more generally, the DEC sentinels on the GEH would see it and manage traffic accordingly. The IMT did not prepare a technical fire projection based on the spot forecast that warned of an unmanageable and hazardous escalation of the fire. The OO had not seen the spot forecast at that time. The IMT felt their road strategy decisions provided for a safe passage of the traffic based on observed and expected fire behavior that would alleviate the considerable problems building up at the roadblocks.

The OO received reports from the sentries at 2000 hrs and 2025 hrs that the fire was quiet and the traffic was progressing satisfactorily. At 2030 hrs the FESA sentry, presumed to be on the eastern side of the fire on the GEH, radioed the OO to say the fire had greatly escalated and was threatening traffic on the GEH. DEC fire tankers that had gathered at the OP for their dinner break responded to the FESA officer's call for assistance. A DEC fire tanker crew drove through the fire to reach the FESA officer's position and escorted him and a semi-trailer truck back through the fire to the western side of the fire using their water cannon to make a safe passage. The DEC crew leader observed that the FESA officer's position was in the middle of the new fire front running south to north across the GEH under the influence of the south west wind change. As they conferred, a small group of vehicles came through the fire from east to west at high speed, the last truck containing a truck driver that had been picked up from his burning truck and had burnt hands. After further discussions the FESA officer and DEC crews agreed that it was imperative that they attempt to get through to the eastern side of the fire to block off any further traffic through the fire zone. Police officers also made the same point. The FESA officer in a light unit in company with a DEC officer, followed by two DEC heavy duty fire tankers made an effort to get through the fire zone from west to east. They came upon a burning truck and the FESA officer determined that the HAZMAT situation was too dangerous and they would have to return to the western side. DEC staff agreed with this assessment and acknowledged that it needed to be a FESA decision in view of the HAZMAT

situation. The DEC staff also noted that the fire conditions further to the east were intense and this also prohibited passage through the fire. The DEC crews took refuge in the gravel pit on the GEH they had been using during the day and waited awhile. They then made another investigation into the fire zone when noticing headlights on the GEH to the east of their position. They discovered three burning trucks with FESA crews in attendance and then returned to the gravel pit and at about 2400hrs were recalled to the OP.

In the meantime, DEC staff were also sent to reinstate the road block on the western side of the fire. The OO advised the IMT of the changed conditions and the IC then spoke to the police officer at the eastern end of the fire who was engaged with vehicles contending with the threatening fire behavior. A report to the OO indicated that a truck had caught fire and the driver's hands burnt.

In view of the potential hazardous materials risk from burning trucks , the IMT (LO) requested FESA take control of the affected section of highway shortly after a briefing at 2115 hrs. The fire behavior and burning truck hazard prevented further travel through the affected zone. Kalgoorlie based FESA staff and resources reinforced authorities at the fire at 2300 hrs. DEC fire tanker crews were keen to continue providing assistance to the vehicles affected or threatened by the fire but were not permitted to attend the burning vehicles due to the fire risk and HAZMAT emergency. At 2400 hrs FESA staff informed the OO that there had been three fatalities in the burnt trucks.

2.5.5 The IMT and Fire Planning

In keeping with the strategy formulated in the morning, the escape of the fire across the GEH was recognized as a new phase of the fire that would require another extended campaign of fire containment line construction in subsequent shifts. Attention focused on the safety of fire crews, the safety of traffic on the GEH, the risk to and from key assets such as power lines and water pipes. Initially fire behavior on the flanks was too severe for fire line construction.

The IMT at the ICC in Kalgoorlie comprised three Sections: Incident Control, Logistics and Planning. The IC was engaged on internal and external liaison and also inspected the fire from the air to gain first hand knowledge. The Logistics Section was working on supplies, meals, accommodation, plant and machinery and communications and other resoucing issues. The Planning Section's prime focus was the updating of the IAP for the next shift, tracking of resources, liaison functions, media, and situation planning focusing on current fire position mapping. The critical fire mapping task depended on intelligence from the field. Information was received from the IC's inspection, the Air Observer in the helicopter and the OP. Telephone communications between the ICC and OP were effective but information flow was conditional upon the staff available, who were working under the pressure of multiple tasks and a dynamic fire situation, particularly at the OP. A public information map (faxed to road houses) of the location and extent of the fire was produced by 1650 hrs and the IAP map completed at 1900hrs. Whist Planning Section was attending to where the fire was, an analysis of where the fire might

go in the longer term was yet to be undertaken. One exception was the IC's hand drawn aerial reconnaissance map that captured the escape of the fire from sector C across the GEH and also projected it south into the salt lakes. A projection that proved to be fairly accurate.

The OO at the OP was also managing a heavy workload with limited support staff in very trying conditions. Whilst engaging with the IMT via phone, he was also liaising directly with police managing the road block at the western end of the fire. He was also fully engaged on his primary function of directing the attack on the fire and keeping his fire fighters safe. He gained useful intelligence on the development of the fire from the helicopter, both directly from his flight and from observers.

The staff managing the fire had a generally sound concept of what the fire could be expected to do each daytime shift based on their knowledge of fire behavior, the fuels ahead of the fire and the prevailing weather conditions. This understanding was also supported and informed by the Boorabbin WTA - FPP. On Friday the IC immediately and correctly interpreted the fire's potential and responded accordingly. On Saturday the run to the north was expected and met with an aggressive and effective pursuit using direct flank attack that was nearly completed. On Sunday it was recognized that the task was to beat the northerly mid morning wind change and if that failed to implement their contingency plan with appropriate safety measures. By Sunday evening these plans had been fulfilled. Unfortunately the next major tipping point in the fire in the form of the overnight wind change was not fully recognized or planned. The reasons are multiple and fully explored in the PIA below, but in terms of this brief fire overview, the main determinant seems to be a mistaken appreciation of overnight fire behavior in the prevailing fuel and weather conditions. The technical guidance, training and systems support for IMT officers in these conditions (e.g. GFR) were also contributing factors. The same can be said for the management of roadblocks.

2.5.6 Overnight Tactics on Sunday 30 December

As for the previous two nights, there would be no overnight IMT or fire crew after hours shift as the visibility of the fire edge was insufficient to operate safely and effectively and planning for the next shift could be achieved before midnight. The exception was the maintenance and replacement of the GEH sentries to ensure traffic would be safe. The OO was in the process of making these arrangements.

The other big change anticipated the next day would be the arrival of extra IMT staff, including a Level 3 IC, specialist GIS personnel, media staff, etc. to address the work load arising from the escalation of the fire to Level 3 and the prognosis of a protracted commitment to achieve containment of the fire.

2.5.7 Strategy for 31 December 2007

The 'General Operational Strategies and Tactics' for Monday 31 December was outlined in the IAP produced at 1800 hrs Sunday 30. Its aims were to *"consolidate constructed*

containment lines along Western side of fire north and south of the GE Hwy. Protect public utility assets (power line, water pipeline and communications towers) through fuel management (scrub rolling). Consider scrub rolling and burning west of Duri Track if conditions are suitable. Look to finalise mineral earth containment lines around entire fire edge, which may include burning out of unburnt pockets near the edge as required. Mop up to DEC standards."

2.5.8 The GHD Chronology Report notes that by the end of the south easterly run on 30 December the fire had progressed 11 kilometres south of the GEH and covered 7500 ha. The dominating feature has been a fire danger index of 'extreme' after the 1000 hrs onset of northerly winds averaging 24 kph and temperatures reaching 43.5^0 with the RH dropping from 14% to 4%. The fire escaped sector C as a number of tongues at different times creating high and low fire behavior on the GEH. These fires coalesce south of the GEH and are eventually impeded by woodlands and salt lakes. A second intense fire front formed by tongues of fire erupts from hotspots along the north east flank of the fire south of the GEH when the south west wind change occurs as predicted by the forecast. The rate of spread of the fire as it approaches the GEH is near 6 kph in 20 year old Tamma scrub fuel. The fire front is angled to the highway such that the western end is on the highway and the eastern end some 4.5 km away. The travel time to the highway would have varied from about 10 minutes to about 50 minutes first impacting the GEH about 2035 – 2040 hrs and extending along a 3.5 km length of the highway. The northerly run was arrested by a recent fire scar about 5 km from the GEH. At the end of this run about midnight the fire has burnt 17, 333 ha on 30 December, bringing the total size of the fire to 21,502 ha.

At about 2040 hrs two trucks were engulfed by the fire front at it crossed the GEH and tragically the three occupants died.

2.6 Fire Overview 31 December 2007 to 13 January 2008

2.6.1 Major Fire Events

The incident proceded for another fourteen days after the fatalities, concluding on 13 January 2008 with the seventeenth shift. The running fire was stopped about 1000 hrs on 9 January when the fire containment lines surrounded the 219 km perimeter enclosing a fire area of 39,520 ha. During this time the weather remained conducive to fire development with the rate of spread of the fire determined largely by the strength of the wind, its direction and the fuel types burnt each day. Wind direction was predominantly from the south east but on occasions moved to the east and north east putting pressure on the western side of the fire. The fire therefore elongated to the NNW and expanded westwards against matching containment lines that endeavored to surround it from both sides working simultaneously north and south of the GEH. The main focus was the western flank. The mixed fuels comprising scrub heath, woodlands, old and more recent fire scars and salt lakes to the south inhibited or promoted the fire to varying degrees sometimes producing a series of fire tongues that forced a very convoluted fire containment line. The IMT considered a more efficient straight containment line running

parallel to the fire and offset sufficiently to enable forward progress to outstrip lateral spread. This strategy was not adopted as it posed a greater threat of the fire building up a run against the containment line with commensurate danger to the fire crews. The tedious and time consuming, but safer and lower risk direct flank attack prevailed.

The most critical issues managed by the IMT were the anticipation of changes in fire development caused by significant wind events, particularly increases in strength or changes in direction, the balancing of resources against fire progress and the continued assessment of values at risk, particularly the GEH and key infrastructure. A consequence of the risk assessment was that the GEH remained closed until the fire was contained. A secondary defense to protect the GEH involved the construction of a wide containment line to the west of the fire comprising chaining and scrub rolling of vegetation.

2.7 Significant Aspects of the Incident After Sunday 30 December 2007

2.7.1 Fire Predictions and Strategic Appreciation of the Fire

On Monday 31 December the IMT realized a protracted fire suppression operation now prevailed with fire suppression Divisions north and south of the GEH and all previous fire containment line construction circumvented. In effect they had to start suppression action anew. A mapped plot of the fire on Monday 31 December showed an outside fire perimeter of approximately 100 km. It was apparent that the fire would take days to contain and make safe to enable the GEH to be opened to traffic.

The three successive IMT's (PFTs Blue, Black, Gold) managing the fire from the 31 December onwards, gained their strategic appreciation of the fire from a number of sources, particularly their recent experience, the weather forecasts and a study of the fuels. Foremost was the experience of the first three shifts that had demonstrated extreme fire behaviour during the day and on Sunday night. This fire behaviour was a result of very high and extreme fire weather that was going to continue into the foreseeable future. Very dry and flammable shrubland fuels extending ahead and around the fire provided potential pathways for fire runs in a number of directions but particularly to the north and west. The IMTs assumed with some confidence that rates of spread of 2 – 4 kmh would be regularly encountered with the prospect of extreme rates of spread up to 10 kmh in the worst weather conditions. Erratic fire behaviour was expected on fire containment lines from gusty wind conditions and variable fuels. This empirical comprehension of the fire was refined and quantified by the IMTs through fire projection plans that anticipated the direction of probable runs of the head fire and identified the dangerous western flank as the likely place for a fire breakout and escalation that might once again threaten the GEH and service infrastructure. Mapped fire projections were a result of close attention to the weather forecasts several days in advance combined with a study of the mosaic of fuel types ahead of the fire. Low fuel areas such as salt lakes, recent fire scars, rocky areas and less combustible vegetation types such as woodlands were considered. Planning officers were supported by the local knowledge of GFR officers, particularly the Regional Manager. The 'Black' IMT also used the South Coast Mallee Heath Fire Table to

corroborate their experiential assessments of fire behaviour. They even tested the South West Jarrah fire table for application to the woodland fuels.

The IMTs were also attentive to the possible 'hinge points' wherein the fire might be expected to make major changes of direction with significant implications for the strategic appreciation of the potential of the fire, the values at threat, implications for containment and the requirements for suppression strategies and tactics matched to changed fire circumstances. Critical junctures in the progress of the fire were identified as 'trigger' points that once reached would instigate a predetermined response plan. An example of a trigger point was the possible change in direction of the fire towards the south west that would require the full activation of the defensive chained containment line along the vermin proof fence and powerline.

The other source of intelligence informing the IMTs strategic planning was of course a very close monitoring and reconnaissance of the actual fire position and behaviour. The fire location was mapped each day, confirmed in the afternoon and checked again the next morning. The fire edge was 'captured' by GPS in the helicopter, by GPS ground reconnaissance and also confirmed by sector reports from fire fighters on containment lines. Satellite derived plots of hotspots were also employed. The plotting of the fire was not an easy task as the perimeter grew to an ultimate length of 219 km and was often convoluted and difficult to read. The fire location maps, even in the latter shifts, showed areas of uncertainty in some sectors of the fire.

The forecast winds over the next few days were from the south east, backing around to north east latter in the week followed by a moderate southerly change. With shrubland fuels ahead of the fire, the IMT anticipated a major extension of the fire to the north with a later risk of a westerly extension from the western flank when the winds became north east. This cycle was somewhat analagous to the pattern of the fire in the first few days. The IMT were now routinely expecting rates of spread of 2 – 4 kmh with possible rates as high as 10 kmh in the most extreme conditions in shrubland fuels. Erratic fire behaviour was expected with variable and gusty wind conditions and was actually reported as such at times from the containment line sectors. The IMT still had expectations that recent fire scars might slow head fires but were now aware that old fire scars could carry a high intensity fire. They were also now aware that in extreme conditions and suitable fuels the fire could attain daytime fire behaviour during the night. Crews monitored night time fire behaviour into the evenings until the end of their shift.

Once again the IMTs adopted the principal objective of keeping the head fire north of the GEH by consolidating the southern Division and simultaneously pursuing the head fire in the northern Division. They would tie the southern end into the salt lakes and use a recent fire scar on the north east side as link for containment lines. A very old fire scar straddling the north of the fire was of no benefit but some woodland vegetation types were expected to assist somewhat. Fall back defensive lines were defined by the Mt. Walton Road on the eastern side above the GEH and by the vermin proof fence track and powerline track on the western side. The main fire threat was seen to be the exposure of critical infrastructure and the potential of the fire to one again come south onto the GEH.

Smoke could also pose a hazard to GEH traffic at any time and the risk to fire fighters was omnipresent. A BOM fire danger warning of 'extreme' was expected for the foreseeable future with temperatures described as 'very hot' with maxima ranging from 31^0C to 41^0C and winds moderate to fresh and gusty at times. Although the weather conditions continued to be severe during the last eleven shifts they were never again as extreme as Sunday 30 December 2007.

The IMTs had a sound strategic appreciation of the fire into the foreseeable future, largely defined by the reach of the weather forecasts and the fuel types ahead of the expected fire runs. The IMTs produced formal mapped fire projections during the last eleven shifts within the Planning Section but it was not necessary to include these in the IAP. The IMT regularly discussed their strategic appreciation of the fire and its likely developments particularly identified hinge points such as wind changes and a potential blow-up condition on 7 January and the timing of the passage of the trough. The possibility of additional fires from lightening was understood. The defensive offset strategy of chaining scrub along the vermin proof fence track in advance of the actual wind shift is an example of the IMTs strategic thinking. Attention was also given to the possibility of fire runs at night particularly in relation to extreme weather episodes, but at the same time the more general expectation of the fire usually becoming quiescent at night was also influential in fire planning. The fire behaved as expected over the ensuing eleven shifts from Monday 31 December 2007 to 9 January 2008. See Appendix 6 Figure 3 for a map of the final extent of the fire.

2.7.2 Resources

In accordance with the SDO's decision on Sunday 30, the IMT (Blue PFT) was augmented with additional staff on Monday 31 December led by a Level 3 IC supported by the GFR Manager. On Friday 4 January the Blue PFT handed over to a complete 'Black' PFT also drawn from the south west regions. At shift 14 there were a total of 106 personnel employed directly on the incident comprising 34 at the ICC, 23 at the OP and 49 in the field on the fire. The Personnel Shift Register for 9 January lists 131 people directly managed by the IMT and active on the incident but does not include the supporting agencies such as the police, MRWA, Shire, volunteers etc. The ICs advise that these numbers were necessary for the proper functioning of the IMTs with a now much expanded fire. The 'Gold' PFT replaced the 'Black' PFT on 10 January with the prime function of the complex demobilization process and management of the now open GEH. DEC staff were supported by a significant number of other agencies including, police, FESA, MRWA and Macmahon, Western Power, Telstra, Water Corporation, Department of Community Development, the Shires of Yilgarn, Coolgardie, Southern Cross and City of Kalgoolie – Boulder and others.

There was a progressive increase in the supply of machinery during the development of the incident commencing with the initial resource decisions when the fire was first reported, deployments on Saturday 29 December, the OO requesting a dozer on Sunday 30 December and culminating in later shifts with nine dozers, four front end loaders and two graders supported by about 17 contractors. More than ten heavy duty tankers were

deployed on containment lines complemented by more than 12 light tanker units with others in reserve or attending to other functions. The effort on the fire front was backed by more than eighty service and materials suppliers, mostly local businesses. There were a number of additional specialist services such as the aircraft contractors, ambulance, counsellors and others.

On January 4 the IMT's fire prediction modeling indicated that the fire perimeter was growing faster than the existing resources could build fire containment line and this signaled the need for more machinery. Additional machinery was also needed to implement new fire suppression strategies such as scrub rolling, scrub chaining and bulldozers working three abreast to make wide effective containment line. The additional machinery was procured when needed. A large chain to be pulled by two bulldozers was obtained for flattening scrub.

The IMT also contemplated night time shifts to extend the productivity of machinery, but the technical difficulties and safety hazards of working on the fire line at night remained prohibitive for the duration of the incident. The IMT extended the day time shifts to their maximum practical extent.

As the incident progressed through increasing numbers of shifts the management of fatigue became vital for the maintenance of production and for safety reasons.

The helicopter continued to play an important role at the fire and it was thought in retrospect that a second helicopter would have been useful on the large fire ground with extended rough fire containment lines and few access tracks making vehicular traffic logistics difficult.

2.7.3 Fire Suppression Strategies and Tactics

The IMT fire suppression strategy had to focus on both the North and South Divisions simultaneously as well as ensuring the Highway Division was properly serviced. Although there were favourable south easterly winds, it was still essential to prevent the South Division growing larger whilst they aggressively pursued the running fire in the North Division. The protection, and in some cases repair, of essential infrastructure such as powerlines, water pipelines and pump stations, railway line and microwave towers was also a critical focus of attention. Fixing damage to the surface of the GEH was an urgent priority. The IMT also checked nature conservation and heritage values that might be threatened by the fire. A prime objective was to open the GEH as soon as it was safe to do so.

Consequently the fire crews built containment line on all of the four sectors in the two Divisions using a direct flank attack. The western flanks were the most dangerous with winds from the east.

The IAP for 2 January (shift 6) listed the fire suppression General Operational Strategies and Tactics as follows:

Build and hold fireline from GE Highway on the western boundary south and east to salt lake.

Build and hold fireline north of GE Highway on the western boundary to 220kva line.

Build and hold fireline from GE Highway on the eastern boundary south to the salt lake.

Build and hold fireline from GE Highway on the eastern boundary north to fire scar and burn out ground between track and existing fire edge.

Protect public utility assets (power line, water pipeline and communications towers) through fuel management (scrub rolling). Consider scrub rolling to protect assets.

Protect Koorarawalyee retreat and the water pumping facility. Document asset protection plan and provide to IMT.

Suppression strategies and tactics in subsequent shifts continued the flank attack on all sides and pursued the head fire. Fire crews gained on the fire during milder part of the day and lost ground during the peak of the day when the fire was at its greatest rate of spread. The fire line production target was especially focused on achieving containment before the more severe conditions occurred on 7 and 8 January and the trough movement brought a potential change of direction of the fire. As the crews closed in on the head fire they were still battling the vicissitudes of the fire with high mid afternoon rates of spread, separate tongues of fire and variable behaviour producing irregular fire edge and a convoluted fire containment line. The great lengths of fire containment line posed an ever present danger of a fire escape and so mop up and consolidation of fire containment line proceeded at the same time as the attempt to surround the fire. One of the greatest containment problems was the very long flame lengths (exceeding 4m) produced by shrubland fuels subject to strong wind. This meant that narrow fire containment lines were easily broached if there was any unburnt fuel contained within them.

The IMTs adapted to the fire conditions and were innovative in applying fire containment strategies that included good use of low fuel areas, multiple machines working en echelon to make wider more secure fire line, leapfrogging tactics to maximize forward progress, scrub rolling and burning out remnant patches of fuel and a major scrub chaining effort offset from the western flank as a fall back position should the fire escape the western containment lines. When the 'Black' IMT commenced on January 4 they even reconsidered the use of water bombers but came to the same conclusion that the 'Blue' IMT arrived at on Saturday 29 December.

The Coordination Group noted in the fire records that the IMTs were punctilious about any change or special notable feature in the weather forecast and ensured that it was passed on by secure means to Operations and shared at IMT meetings. Any change to the expected weather conditions was potentially critically important for fire fighting tactics and the safety of all on the fire ground. The IAPs continued to formally identify all known hazards and ensured that fire fighting tactics and management of each Division and Sector operated safely. Dead man zones, safe anchor points, escape to the burnt out area, and refuge zones were specified.

2.7.4 Management of the GEH

When the fire escalated and enveloped the GEH at 2040 hrs on Sunday 30 the GEH was blocked and remained closed to public traffic for the remainder of the incident until 10 January 2008. The extended closure was obviously initially a response to the intensification of the fire threatening the GEH and the same evening became an ongoing conservative reaction to the fatalities. However, the protracted closure was also essentially pragmatic and prudent. It was pragmatic because the GEH needed to be inspected and repaired to be safe for traffic, and later on it was prudent because the fire was still not contained and although the active head fire was some distance from the GEH the IMT knew it was only a couple of hours away with any onset of extreme fire conditions brought about by northerly winds. The operations of agency staff working to protect or repair infrastructure and the activity of fire fighters and logistic supplies through the Highway Division made public traffic exclusion a highly desirable safety provision. Initially after the fatalities the IMT estimated that the end of the week (about 4 January) was the achievable target for opening the GEH, but when Black team arrived further calculations were made about the production rate of containment lines and it was evident that control of the fire might be another week away. The IMT applied a risk assessment process to the decision to keep the GEH closed and were assisted in this process by the OAMG, DEC senior staff and supported by the most senior Agency and Government leaders independently and acting within SECG. From thereon the IMT simply stated that the GEH would be opened when it was safe to do so. Perhaps surprisingly, there was considerable criticism and complaint about the continued closure of the GEH, particularly for commercial reasons. ICs reported that they were subjected to considerable pressure to open the GEH recreating a situation somewhat reminiscent of the third shift on Sunday 30 December. The road blocks continued to consume considerable resources in the IMTs, particularly the IC, Liaison Officer and ISU. ICs channeled road block management to themselves and sections of their IMT, particularly complaints and pressures, so Operations could concentrate on direct fire suppression activities.

From December 31 to January 9 the GEH closure was well resourced and well managed. MRWA took the lead in physically arranging and maintaining the road blocks using their contractor's Macmahon. They confirmed detour arrangements and publicized them on their web site. The road blocks were ensconced near Yellowdine and Coolgardie. A staging area was set up at Southern Cross to warn travelers that the GEH was blocked near Yellowdine and to avoid the problem of traffic accumulating along the GEH at places with few facilities and no immediate prospect of passage through the fire zone. The staging area also served as an organization point for fire crews and agencies. The road blocks were carefully managed and enforced with anyone hoping to pass through them needing written authority. For the most part those passing through the road blocks were agency staff involved in the fire operation or the servicing of infrastructure. A regular police presence provided formal enforcement in support of MRWA staff and contractors. There was some concern about unauthorized travelers using the rail line service road to bypass the road blocks and fire fighters were warned to be alert for unauthorized vehicles.

The opening of the GEH roadblocks was conducted with great care as described by the words of one IC: *'the opening of the roadblocks was planned and executed with precision to ensure the safety of the traveling public'.*

2.7.5 Interagency Cooperation

With the formation of the OAMG at Kalgoorlie chaired by the police Superintendent and the convening of the SECG chaired by the Acting Commissioner of police all relevant agencies combined to ensure that adequate resources were provided, communication channels were maintained, information shared and solidarity of purpose fostered. Government and agency leaders from the Premier down were kept informed and when appropriate gave press interviews and press updates. All processes were subject to the constraint of an Arson Squad investigation on behalf of the Coroner. There was no formal IMG body as the interagency integration and coordination was effectively done through the OAMG and operational matters managed by the HMA. The IMG existed in the form of the various agencies operating in the field in a coordinated way attending to their responsibilities.

2.8 GHD's Independent Reviews of the Incident

2.8.1 GHD Fire Development Chronology Report

The GHD Fire Development Chronology June 2008 provides a very detailed and technical account of the behaviour of the Boorabbin fire from the preconditions of the environment, fuel and weather to the actual fire development and conclusion of the suppression action that achieved containment of the fire after thirteen days; 28 December 2007 to 9 January 2008 inclusive. A notable feature of the preconditions was the lengthly period of drought that had reduced vegetation moisture content to very low levels thus making it extremely flammable. The drought precondition combined with severe fire weather leading up to Sunday 30 when conditions became 'extreme' creating 'blow-up' fire behaviour and very challenging containment prospects.

The report divides the fire into four phases: initial fire spread, fire escalation north of the GEH, fire escalation south of the GEH and the fourth phase fire growth and containment after 30 December 2007. Like DEC's PIA and the Findings and Actions report, the GHD fire chronology report concentrates on the first three days that lead up to the fatalities, but also completes the account by reviewing the whole incident. The fire chronology report must of necessity also refer to the suppression actions as they had a marked effect on the progress of the fire as fire containment lines shaped and finally halted its spread. The interaction between the fire and the suppression actions and the reasons for the interplay between both elements is well covered. The report is notable for its meticulously accurate and detailed information and interpretation of the fire and for the clarity of presentation, particularly the graphical depictions of the various stages of development of the fire and the explanation of the influences that were determining that development.

DEC recommends the GHD Fire Development Chronology Report as an authoritative and complete account of the physical behaviour of the Boorabbin fire.

2.8.2 GHD Operational Review of the Incident

The GHD Operational Review July 2008 gives an account of the way the Boorabbin incident was managed. It is set against the background information on fire behaviour provided in the Fire Development Chronology report. The prime tasks of the Operational Review were to provide *'an accurate and discriminating account of the operational management of the fire to identify the causes and contributing influences that resulted in the significant fire outcomes. The report is also required to identify 'identified learning points' arising from the operational management of the fire that link to a set of recommendations.'*

The Operational Review takes a 'systems' approach that compares management actions at the fire against standard operating procedures and guidelines employed by DEC in the overall context of the AIIMS guidelines for emergency incident management. GHD adopts the classic fire management methodology of Prevention, Preparedness, Response and Recovery phases to structure the report. The Operational Review report also uses the same time phases to segment the development of the fire as the Chronology report, thereby facilitating cross referencing.

The AIIMS emergency incident management team structures and functions are used to describe the operations of the Incident Management Team at the fire. The planning, decisions and actions of the IMT, SDO, fire crews and other DEC staff are gauged against DECs fire operational guidelines and accepted practices. These same DEC guidelines and practices are also reviewed for their efficacy in the context of a remote area incident such as the Boorabbin wildfire, and also against the broader background of best practice in Australia.

Observations are also made about the multi agency nature of such incidents and the role of parties other than the HMA in the context of State Emergency plans and guidelines. The report identifies 'learning points', many of which become recommendations for adpations and improvement to DEC's current practices. Recommendations are also made about the role of other agencies assisting the HMA with a view to improving joint operations and teamwork. Consistent and common guidelines, training and systems are the focus of these recommendations.

As part of the learning process the report acknowledges the practices and actions at the incident that were done well so as to reaffirm them, and distinguishes those that might have been done better. Where the guidelines or systems are deficient, improvements and remedies are suggested.

DEC has thoroughly reviewed the GHD Operational Review and accepts, with only minor amendment, all of its analysis, conclusions and recommendations. DEC's Findings and Actions report lists the specific details of DEC's commitments resulting from its acceptance of the GHD Operational Report.

SECTION 3

POST INCIDENT ANALYSIS

SECTION 3 POST INCIDENT ANALYSES

3.1 Introduction to the Analysis

As explained in Section 1.11, the usual discrete chronological sequence of AAR – Debrief – PIA – Findings and Actions, has been displaced by the complexity of this incident and the additional dimension of the Coronial investigation process. The several enquiry processes have been concurrent and continuous for much of 2008 with several key elements running in parallel namely the PIA, GHD reviews and Coronial investigation entailing the preparation of Witness Statements. As the various enquiries progressed it became apparent that there were a number of influences bearing on the incident and its management that were out of the ordinary, and interacting. It has therefore not been possible to simply isolate each consideration and deal with it only once as a topic in a chronology. It is hoped that the resultant necessary repetition of issues from various vantage points is useful in finally forming a complete understanding of the incident.

Complex incidents are composed of many elements and the challenge for the enquiry processes is to assemble these so a coherent portrayal of the overall picture emerges. The IRT believes that the debriefs, PIA, GHD reports and Witness Statements, when combined, present a comprehensible, consistent and credible summary of the incident and the events that produced the critical outcomes. The IRT did not have to deal with confused, disparate or poorly documented recall by DEC staff or contending views of what happened or why it happened. As the enquiries commenced immediately after the tragic incident, those involved had vivid and accurate recall and all known documents were recovered. Issues that at first seemed inexplicable were eventually understood and subtle aspects of some decision making comprehended. The most difficult aspects to pin down were those matters that rely on the experience and judgment of IMT leaders, particularly risk analysis processes that might not have been previously disposed to well defined procedural solution. A cognitive example is the difference between the expected performance of a Level 2 IC and a Level 3 IC, and a procedural example is the inadequate interagency roadblock procedures.

As the DEC sponsored enquiries have been introspective, the PIA is not informed by the views, experiences, testimonies and documentary records that many others outside of DEC who were involved in the incident can no doubt contribute. These will emerge in due course from the Coronial Inquest and DEC will incorporate them into a revised Findings and Actions report. At this stage of proceedings DEC is not aware of any input, formally or informally, from outside DEC sources that would cause the PIA to reach different conclusions from those presented.

The overarching context of the fire is that it occurred in a remote region subject to an evolving understanding of local fire behaviour and a history of limited fire suppression response, combined with extreme weather conditions and coinciding with an arterial main road and key infrastructure assets. This conjunction of circumstances and causal factors is

atypical of DEC's otherwise extensive fire fighting experience and attendant post fire analysis.

3.2 PIA Structure and Analytical Process

The subject matter for the PIA was largely derived from the debriefs. Most are explicit items, issues or recommendations from participants in formal debrief sessions. No subjects of substance were excluded from the PIA by the IRT (see list in Section 1.12). Matters ranged from simple specific items such as the staking of tyres to more complex questions such as the way DEC's IMS has evolved.

The structure of the PIA reflects the structure of DEC's enquiry process by dealing with the debrief context, the IRT analysis, a technical expert review process (IRT and FACG) and finally a DEC Corporate evaluation and approval (the Findings and Action Report). Each topic is therefore presented as a debrief account followed by an IRT/FACG analysis that produces a set of conclusions and proposed actions for consideration by DEC senior management.

Whilst this PIA process goes beyond the FOG 31 prescription, and contributes to a wider inquiry process it is still essentially a review of DEC fire management and incident management procedures and technologies applied to an incident. It therefore tends to focus on DEC's standard operational procedures, guidelines, practices and IMS in the AIIMS context. It is hoped that any difficulty non fire practitioners might have in dealing with the necessary technical references will be resolved by the Findings and Actions Report that summarises and authorises the outcomes from the debriefs and PIA.

PIA SUBJECTS

3.3 Fire Management Background in the Goldfields Region

3.3.1 Fire Management History in the GFR

Debrief Issues

Many of the issues raised in debriefs were discussed in the context of the history of wildfire occurrence and response in the GFR and the evolving experience and knowledge of GFR staff and DEC staff generally in this environment.

There was acknowledgement of the variation in fire 'culture' between the regions of the south west and the more remote regions that result from substantially different wildfire threats and assets, suppression resources and traditions of fire management. Fires in the GFR are often located in remote and extensive areas of spinifex grassland deserts or expanses of shrublands, mallee heath or woodlands with few assets under threat or resources available to combat the fires. Most fires do not threaten important built assets and are only monitored and allowed to self extinguish when they inevitably run into areas

of naturally low fuels such as salt lakes, previous fire scars (areas of visibly reduced fuel from a previous fire) or woodlands that naturally have insufficient fuel to carry a fire. Officers in the GFR have experience and knowledge of fire behaviour in this environment commensurate with the time spent in the region and their functional roles in attending or monitoring fires. Fire management activities are increasing with the allocation of additional resources in recent years that includes a full time Fire Coordinator. The Wildfire Threat Analysis and Fire Prevention Plan for Crown Lands between Coolgardie and Southern Cross (WTA-FPP), that takes in Boorabbin National Park, was produced in consort with FESA, local government and other agencies. The program of fire planning and preparation works specified in the plan is being implemented.

The accumulated experience of current and former GFR staff has formed certain expectations of fire behaviour and appropriate responses to fire. This includes a general belief that fires will often partly self extinguish overnight and restart the next day in average summer conditions (the 'standard expectation'). Fires in heath or shrubland fuels are expected to travel fast under the influence of strong winds but to be arrested by areas of low fuels such as salt lakes and recent fire areas where vegetation (fuel) has not had time to regenerate sufficiently to carry another fire. Woodlands are also known to halt or restrict the spread of fires as there is not usually enough continuous fuel on the ground to carry a fire. Given these factors, fires are often too remote and too large to present any prospect of containment with readily available resources and usually do not warrant the large expenditure of funds that would be necessary to suppress such fires considering the lack of built assets at risk. Note that the environmental damage of frequent fires in some vegetation types in the GFR and other remote regions is recognized by DEC as environmentally significant and deleterious, but the same constraints of cost and practicality apply to this impact as for valuable built assets.

The GFR has intervened in wildfires where the assets at risk were compelling and two examples of such fires impacted on the GEH in the vicinity of the Boorabbin fire. They were the Boorabbin (Gilgai) Fire (19 – 21 January 1998) and the Woodlands National Park fire GF 5 (detected on 9 Janauary 2001 and extinguished on 19 January 2001). The 4000 ha Boorabbin (Gilgai) fire was contained by suppression action by CALM forces and the 220,000 ha GF 5 fire was brought under control by a combination of suppression action and rainfall.

DEC fire suppression forces coming to assist GFR bring with them the Department's best competency and resources in fire fighting, usually drawn from neighbouring regions and the south west. However, the members of the preformed teams from the South West Regions would not necessarily have a lot of experience in the shrubland fuels of the GFR as they are accustomed to fighting fires in the dense forests of the south west or in heath vegetation in coastal regions. Staff from other regions would be aware of this limitation and tend to defer to the knowledge and experience of local staff. As it happened, the IMT leaders at the Boorabbin fire all had experience of the GFR environment and so local knowledge and the traditional expectations of fire behaviour was appreciated and influential.

Coordination Group Review and Discussion

It is important for anyone examining the circumstances of the Boorabbin fire to understand the history of fires and fire fighting in the GFR and the special conditions and constraints that apply. The large expanses, sparse human occupation, limited development and infrastructure, extensive scrub, spinifex grassland, mallee, heath and woodland fuels, severe climate and limited fire fighting resources make for a special set of circumstances for fire management.

Suppression responses by DEC are limited to high priority response zones and high value assets with a particular focus on the conservation lands and values DEC manages.

Some of the senior staff in the GFR have extensive experience of fires and fire management in the GFR, particularly the long serving GFR Regional Manager. Some former GFR staff have transferred to other places and taken their experience with them, but in total there are not many DEC staff with direct experience or knowledge of GFR fire. DEC's extensive fire research has not yet focused on the GFR and the nearest analogues to the shrublands and heath and mallee of the GFR fire environment would be found in the heaths of the South Coast Region and the Mid West Region, but with notably different weather regimes from ocean influences and also some structural and compositional differences in fuel. Fire fighting activities and experience of these coastal heaths is more widespread in DEC as the assets and geography in these regions have attracted a higher order of fire management and response than the GFR. However, in recent years DEC has increased the fire management and fire fighting capacity in the GFR and expects to continue this trend. The Department's well developed fire fighting resources in the south west of the State are increasingly available for deployment to GFR fires. The Boorabbin fire is the most advanced example of this trend.

In view of the limited experience with GFR fires in Preformed Teams (PFTs), it will be important to ensure that local knowledge is available and employed to best effect in the IMT structure in future. There was a very deliberate effort to do exactly that at the Boorabbin fire when the SDO selected key IMT staff that did have experience of the GFR and accepted the RDO becoming the IC. In retrospect, it would have been better to have the PFT led by an experienced PFT IC (the Blue Team IC was ill), with the local staff occupying supporting and advisory roles where their local knowledge can be effectively focused. For example, the very knowledgeable GFR Regional Manager (who was on leave in Perth at the time) would be an excellent Deputy IC so he can input fire monitoring and behaviour information, advise on local geography, contacts and resources, attend IMGs and OAMGs with the IC and do high level liaison. The simultaneous routine running of the region during a wildfire can be delegated to another experienced local officer.

Another important lesson from the Boorabbin fire is that in view of DEC's limited fire fighting resources in the GFR it is necessary to involve as many other agencies and contractors as possible so it becomes a joint local effort augmented by outside resources. Other organizations may well be able to make prior arrangements that call on support

from other parts of their agencies, as DEC does. With hindsight it is apparent that the IMT tried to do too much with their own resources, and although they called for further outside assistance from DEC and other local agencies the resources became overtaxed when the fire situation escalated. The lesson is that Level 3 GFR fires necessitating suppression will inevitably require support from a number of regions and from a number of agencies and will probably need to be stepped up to State level decision making and resource acquisition.

The technical aspects of fire fighting in the GFR needs further attention. DEC will look at the formal research needs and determine what might be essential for future fire management. The Coordination Group is conscious of the fact that fire research is very expensive and there are a limited number of scientists available for this specialized program and many pressing demands throughout the State, including the remote northern savannas. It may be that an examination of the technical fire behaviour aspects of fire fighting in the GFR will suggest that existing knowledge from elsewhere, such as the South Coast mallee heath fire behaviour tables, can be interpolated and adapted as a surrogate for specifically GFR derived information. DEC is closely observing the progress of the Bushfire Cooperative Research Centre Fire Dynamics Study at Ngarkat South Australia on mallee heath fuel types in the expectation it will provide useful information for mallee heath fire appreciation in Western Australia. Other operational questions such as fire fighting strategies, techniques, equipment and procedures suited to the GFR should also be examined. Communications is another special aspect of fire fighting in the GFR, as is accommodation, transport, aircraft use, water supplies and equipment caches. The debriefs have attempted to capture the things that worked well at the Boorabbin fire, such as the use of the helicopter and these will be reinforced for future GFR fires. Traditional wisdoms and procedures that simply 'happened' as they should have, are also noted as a way of reaffirming these practices. The excellent briefings and safety awareness presentations to fire crews was notable.

On reflection it is apparent to the FACG that the unique conditions and constraints of fighting fires in the GFR did play a very significant part in producing the outcomes of the Boorabbin fire. The improvements and lessons learned suggested throughout the PIA will equip both local and incoming fire fighting teams with better operating procedures and guidelines and improved knowledge of the unique GFR fire fighting conditions.

Recommended Actions

1. Large fires in the GFR involving outside resources will integrate local staff into the IMT to best effect with the IC supported by a local senior officer as Deputy IC.

2. DEC will review research needs for fire behaviour modeling in the GFR and also consider what adaptions of existing knowledge and models can be applied.

3. The positive and negative operational experiences from Boorabbin will be built into training and awareness forums for IMTs so PFT staff will in future be prepared for the special fire management conditions that pertain in the GFR

4. Fire management instructions will be amended to accommodate the improvements identified and accepted throughout the PIA process. Where they are specific to the special conditions of remote regions such as the GFR, they will be noted as such.

3.4 Fire Preparedness

3.4.1 Wildfire Threat Analysis & Fire Prevention Plan (WTA-FPP)

Debrief Issue

In 2003/04 CALM (now DEC) and FESA prepared a Wildfire Threat Analysis and Fire Prevention Plan for crown lands between Southern Cross and Coogardie.

There was general agreement in debriefs that the WTA-FPP for the Boorabbin area was a very useful document, particularly for the Planning Section of the IMT and for staff unfamiliar with the GFR. Track maintenance specified by the WTA-FPP that had been implemented was beneficial to fire suppression. It is noted that the GFR has shared the WTA-FPP with other agencies, but it would benefit from even more participation by other agencies. The debriefs recommended that a fuller engagement of relevant agencies be pursued in the GFR and the applicability of the WTA-FPP to other areas of the State be examined.

Coordination Group Review and Discussion

The IMT commented that the WTA-FPP was a useful source of local information for incoming staff. It was particularly useful for detailing assets at risk and identifying the relevant management agencies. The information presented in the WTA-FPP complements local officers with local knowledge working in the IMT. The suggestion that WTA-FPPs be prepared for other strategically important areas that currently do not have them is being evaluated by DEC through a pilot study in the south west regions conducted by a consultant fire expert.

It is noteworthy that the works program schedule specified in the WTA-FPP for the Boorabbin area has been progressed and was ahead of schedule. The work done on tracks such as the Merbine Track and Duri Track helped to make them more serviceable for the fire fighting effort. The works program also contributed to the local knowledge of local staff with respect to geography and fire preparedness at Boorabbin National Park and surrounds.

Section 8 of the WTA-FPP (Fire Behaviour and Intensity) will be augmented with more information on the use of mallee heath fire behaviour prediction models and tables

alluded to in Table 5. However, WTA-FPPs are not intended to be a substitute for AIIMS procedures or the training of IMT members in the essentials of fire planning, management and suppression. More specifically, DEC does not expect WTA-FPPs to be the source of fire behaviour understanding in IMTs, but they should be a complementary and confirming source of information for IMT personnel not based in the WTA-FPP subject area.

Assessment of the accuracy of fire history mapping and currency of fuel loadings and the availability of such maps in useful formats for fire planning and suppression will be a component of the review of the Goldfields WTA-FPP.

Fire suppression preplanning of OPs and the documenting of other supporting infrastructure (eg settlements, roadhouses, major towns, communications, airstrips, water supplies etc) will also be considered for inclusion in the WTA-FPP.

The WTA-FPP for the Coolgardie to Southern Cross crown land will be generally reviewed in the light of the Boorabbin fire experience to determine if any further improvements can be made.

The Coordination Group notes that the WTA-FPP that covers the Boorabbin area is indicative of the fire protection initiatives and improvements that DEC, FESA and the State Government have been taking in recent years in the GFR. This heralds a progressive movement from the traditional largely passive observing and monitoring of wildfire to a more proactive management and response capability. It also reaffirms the need for relevant agencies to work together through mediums such as the WTA-FPP to produce preplanned coordinated fire protection measures in the GFR. On this score, DEC's GFR will continue to seek the active participation of other agencies in the annual review of the WTA-FPP. It is also envisaged that the WTA-FPP will provide a suitable vehicle for documenting and coordinating new multi agency improvements to fire preparedness and prevention along the GEH, particularly in terms of DECs contribution and responsibilities.

Specific fire prevention measures recommended include better designated traffic parking areas, truck bays, or travelers rest areas. It would be best to rationalize the existing informal parking areas that appear to have been created only because there was an accessible gap in the vegetation by the side of the road. Properly designed and strategically located travellers rest sites and road train parking and turning areas in less fire prone vegetation, such as woodlands, with suitable facilities and information on fire prevention and reporting might help prevent incidents like the Boorabbin fire. As the MRWA installs such facilities as a normal part of road infrastructure this suggestion should be practical and achievable with interagency cooperation and commitment.

The debriefs also noted that fuel modification to protect 'lifeline' infrastructure and reduce the risk of fire escape from high risk sites such as travelers rest areas, might be worth considering. Both of these suggestions should be practical in the form of fire breaks, perhaps also doubling as service access for infrastructure such as water pipes,

powerlines and telecommunications facilities. More broadscale fuel modification such as prescribed burning and targeted physical reduction of fuel (slashing, chaining, rolling, machine work etc) is a little more complex and challenging. Matters such as environmental impacts, protection of rare plants or animals, ecological change, visual amenity, indigenous and European heritage need to be thoroughly evaluated. The risks, costs, technical capability, scale, collaboration between agencies and special constraints of fuel reduction through prescribed burning would also need to be carefully assessed prior to inclusion in the WTA-FPP. DEC will evaluate the practicality of such measures with a view to expanding the works programs specified in the WTA-FPP.

The tenure of land affected by prevention measures may determine which authority takes primary responsibility for agreed plans, but might also require combined efforts where land management responsibilities adjoin or interrelate. DEC is undertaking an assessment of these recommendations and will involve other agencies as appropriate.

Recommended Actions

1. The WTA-FPP for the crown lands between Coolgardie and Southern Cross will be reviewed and the suggested additions made for the 08/09 fire season and subsequent fire seasons.

2. The WTA-FPP will be used to capture multi agency improvements to fire prevention and preparedness in the Boorabbin National Park and other crown lands along the GEH.

3. DEC has commenced a project to ascertain the feasibility and benefits of extending the WTA-FPP to other regions.

4. DEC will work with road management authorities (MRWA and Shires) to initiate combined fire mitigation measures within road reserves, DEC managed lands and other crown lands adjoining road reserves statewide

3.4.2 Incident Preparedness and Response Plan (IPRP)

Debrief Issues

The IMT found the Goldfields IPRP to be a very useful reference document, particularly for IMT members not familiar with the GFR. The GFR has annually updated the IPRP, but further improvements are recommended, including the nomination of after hours and holiday period access to contractor's machinery and plant and other services.

Coordination Group Review and Discussion

FOG 07 Guidelines for Incident Preparedness and Response Plans, instructs DEC's Regions and Districts to prepare IPRPs and conduct an annual revision of the plan by 31

October each year. The GFR IPRP complied with FOG 07 and was available to the IMT who found it very useful for informing them about local logistics, communications and liaison with other organizations. The debriefs noted that the experience of managing a large scale fire revealed some changes and improvements to the IPRP which are recommended for adoption.

The IPRP currently contains quotes for the use of contractor's fire fighting machinery and plant. Pre-season arrangements for the availability of this equipment, particularly in holiday periods, would provide more certainty and efficiency when trying to source these resources during a fire.

Recommended Actions

1. The IPRP annual review for the GFR and other remote regions will include attention to pre-organizing machinery and other key services prior to the season, particularly for peak holiday periods.

3.4.3 Fire Personnel Availability in Remote Regions

Debrief Issues

Some debriefs questioned the adequacy of resources on detention in the GFR, particularly during holiday periods. It was noted that when the fire occurred there was only the Principal Point of Contact Officer (Regional Duty Officer) and two officers with fire experience available to attend to the fire. The availability of staff was also influenced by the end of year holiday period. The small number of staff with accredited fire skills in the GFR means that the absence of any key staff, such as the Fire Coordinator, the Operations Officer or the Regional Manager can leave a significant gap in a local IMT. At the time of the fire the Regional Manager was on a short period of leave in Perth having been the RDO over Christmas, but was contactable by phone. The comments in debriefs were probably coloured by the experience of staff from south west forest Regions that are able to run well resourced fire detention rosters. These Regions are relatively well endowed with fire suppression staff and therefore marshalling of these people on rosters is routine. Remote regions such as the GFR have had neither the staff numbers nor the need to emulate the size of the South West Regions fire detention system. The GFR IPRP spells out fire detention standing orders that ensure there is always a Duty Officer and principal point of contact officer (usually the same person) on duty in accordance with the fire hazard of the day. The GFR Duty Officer has the discretion to vary the fire detention regime as needed.

All of DEC's regions depend on reinforcements from neighbouring regions to deal with large or sustained fire incidents from time to time. Over the years DEC has moved to increasing the mobility of its South West, Mid West and South Coast fire suppression resources. The same pattern has developed with resources needed to implement the prescribed burning program. Rostered Pre Formed Teams cover all regions during the

southern fire season but in practice are expected to be a follow-up complement to the initial and sometimes critical initial fire response staffed by the local District or Region.

Coordinating Group Review and Discussion

The Coordinating Group acknowledges the concern raised in debriefs about the limited capacity of remote regions such as the GFR to staff substantial fire detention resources and deploy adequate first shift IMTs. In response to the debrief comments; it has to be recognized that remote regions will not, in the foreseeable future, have the quantum of resources available to South West Regions, but also it should be acknowledged that DEC does ensure that fire detention standing orders provide for the essential base level response to fires. Also, it should be acknowledged that fire resources, fire response capability and fire management programs are expanding and developing in DEC's more remote regions, including the Kimberley. The GFR demonstrates this trend with the recent appointment of a full time Regional Fire Coordinator and work done on WTA-FPPs and further planning and programming of works for new land acquisitions. Further improvements are contemplated and others, such as upgrading the regional office as an ICC, will result from this review.

In retrospect, the Coordinating Group believes that once the fire had escaped there was no prospect of containing the Boorabbin fire with GFR resources regardless of any staff detention arrangements. The fire detention arrangements prevailing at the outbreak of the Boorabbin fire did not hamper the prompt and correct response to the fire that was taken by the Regional Duty Officer, who then became the IC. The IC made an accurate appraisal of the first phase of the fire, decided on the scope and kind of suppression response needed and promptly called for assistance from DEC's central fire duty system and from local contractors and agencies. Although he did not have many experienced staff on Fire Emergency Availability, the team of two sent to reconnoiter the fire with a light unit were very suited to the task. The absence of the Regional Manager on leave is a notable contingency as he has long experience in fire management in the GFR and is an important part of the fire leadership team. The IC phoned the Regional Manager at his holiday location in Fremantle on a number of occasions as a courtesy to inform him about the fire and also to share the matter with him. They conferred and the Regional Manager accepted the IC's assurances that he did not need to return to duty on account of the fire. A reassurance no doubt enhanced by the knowledge that a preformed team would support the IC. The Regional Manager reported for duty at DEC's Perth office early on Monday 31 December when the fatalities had occurred and returned to Kalgoorlie as soon as possible thereafter (1 January 2008) to assist with the ongoing management of the fire.

DEC acknowledges the dedication of staff to duty that often conflicts with their personal and private lives over their many years of involvement in fire management and fire emergency availability rosters. Being contactable even when not on duty is not a formal requirement of the fire detention system or even part of their terms of employment, but is often volunteered, as it was on this occasion.

Recommended Actions

1. DEC will review standing orders for fire rosters and resourcing for remote regions such as the GFR considering the increasing land base managed and the limitations of distance and time for first response capability.

2. DEC's review of detention standing orders in remote regions will examine the capacity of regions to produce an adequate first response to fires, particularly Level 2 and Level 3 fires, and the relationship of that response capacity with the rostering of IMT staff in the South West Region. This matter will need to be considered in the context of risk management for multiple fires across several regions in extreme weather conditions and also the logistical issues of time lags and distances involved in reinforcing remote regions.

3. DEC will examine the possibility of rostering by zone rather than region and link it to statewide preparedness levels.

3.4.4 Contractor Resource Availability

Debrief Issues

It was noted in debriefs that there was some difficulty in obtaining contractor earthmoving machinery during holiday periods in the GFR. It was suggested that more pre planning of the availability of contractor resources and other 'after hours' services would be advantageous. This can be accommodated within the IPRP that already addresses these matters to some degree.

Coordinating Group Review and Discussion

DEC's earthmoving equipment resources at large fires are usually complemented by private contractors, particularly bulldozer operators. It is best to preplan the availability of such plant and equipment as it may be difficult to find and mobilize at short notice. The problem is exacerbated during holiday periods, such that even a mining region like Kalgoorlie, presumably replete with contractors, might be found wanting during an industry wide shutdown period. The practice adopted in south west Regions of preplanning the availability of essential suitable machinery should be examined in relevant remote regions such as the GFR. The question of the training of contractor's machinery operators for fire situations also needs attention.

It is acknowledged that contractors may not be particularly interested in formal arrangements that are not commercially attractive or might otherwise interfere with their routine work or the holidays of their staff. DEC staff will have to work with the realities of the availability of contract machinery for their individual regions.

Although Logistics section had some difficulty finding and commissioning machinery, it is not considered that the pre-arranged availability and hire agreements significantly diminished any critical fire suppression action.

Recommended Actions

1. Preseason fire planning will as far as possible include arrangements with local contractors to make fire fighting machinery and operators available particularly during high risk and holiday periods.

2. Basic fire fighter training will be provided to contractor's staff so their machinery operators can operate safely and effectively during fires. The IPRP is the appropriate place to document arrangements.

3.5 Initial Fire Response

3.5.1 Fire Detection and Notification

Debrief Issues

The debriefs noted there is no aerial fire surveillance or fire watch towers detection system in DEC's regions outside of the South West Forest Regions. Wildfires are usually reported by landowners, leaseholders or travellers or detected by remote sensing (satellite images). Although the Boorabbin fire was reported reasonably early in its development and accurately located, the experience has prompted the debriefs to suggest that an improved system of informing the public about how to report fires could be beneficial. In particular, a means of informing travellers on major routes such as the GEH how to report a fire and its location.

Coordination Group Review and Discussion

The debriefs correctly note that the GFR does not have the fire towers and routine fire spotting aircraft used in DEC's South West Regions and therefore relies on reports from the public, landowners, neighbours, industry, satellite 'hotspots' and DEC staff. Duty officers routinely view the Sentinel and Landgate satellite systems on the internet to detect wildfires and to monitor known fires. There may be a lag between the initiation of the fire and its appearance on the satellite images and there may also be a gap between viewings of the system, so it is not a continuous surveillance system. This is appropriate considering the vast scale of the region and the fact that most fires are started by lightning and are remote. Most fires fall within response zone C (third priority – inaccessible), with fewer in Zone B (second priority – accessible) or Zone A (first priority – rapid response). The Boorabbin National Park area is in a response Zone A.

The Boorabbin fire was efficiently notified to DEC by a nearby resident who also attended the fire and gave subsequent reports. This neighbour to the Boorabbin National

Park was able to report the fire by phone through the DEC GFR after hours contact system. Shortly after this the fire was notified to DEC by the FESA Communications Centre in Perth. These reports arrived in the fairly early stages of the fire, when it was still quite small in area, and so detection of the fire was perhaps more timely than most wild fires in the GFR but did not materially contribute to the suppression outcome as the fire spread quickly due to pronounced fire behaviour, extended response distances and limited resources immediately available. However, the issue of fire detection and reporting in the GFR is stimulated by this fire.

The significance of the threat of fires to the GEH is recognized in the WTA-FPP and the IPRP, and has tragically become a reality with the Boorabbin fire. However, DEC does not see any practical prospect of transferring the fire lookout tower or aerial surveillance systems used so effectively in the South West to the GFR as the distances and costs are prohibitive and the efficacy questionable with the innate limits to fire suppression responses.

The debriefs have suggested that facilities to assist early detection and reporting of fires can be made along major roads such as the GEH. Early detection is a function of the constant traffic flows along the highway with a general improvement in reporting capacity resulting from the ubiquitous use of mobile phones and the phone reception network along the highway. A further improvement would be some form of road distance markers so the exact location of fires on otherwise featureless stretches of road can be reported. Roadside pull-offs, parking bays or travellers rest areas can also be signposted with their identity and location. As the Boorabbin fire illustrates, road reserves are high risk locations for fires.

Road reserves are managed by Shires or MRWA and so DEC managed land (e.g. Boorabbin National Park) may be disjunct from roads such as the GEH and thus limit DEC's capacity to directly or unilaterally implement some of these recommendations.

Recommended Actions

1. DEC will initiate consideration of improved fire reporting systems on highways with the relevant road management agencies (MRWA and Shires). DEC will assist with the fire reporting information needed for any advisory signs to be located on land managed by other agencies.

2. DEC will review its current systems and procedures for fire detection and reporting in the GFR and other remote regions to see if cost effective improvements can be made.

3.5.2 Fire Cause Investigation

Debrief Issues

The formal fire cause investigation by DEC was not raised as an issue in debriefs but some review and comment is made by the Coordinating Group in view of the seriousness of the fire outcome.

Coordinating Group Review and Discussion

The Department's Fire Management policy includes a commitment to, *"where practical, attempt to identify the origin and cause of wildfires on lands under its control and will investigate fires that result in damage to private or community property. Where regulations have been breached, the Department will take appropriate action to identify and, as appropriate, arrange prosecution of offenders. The Department does not have jurisdictional responsibility to effect initiatives for arson prevention or preparing communities for wildfire events. However, the Department will work closely with the Fire and Emergency Services Authority, the Police Arson Squad and local government authorities in developing and implementing coordinated fire prevention and preparedness programs."*

The Department followed this policy at the Boorabbin fire by formally investigating the cause of the fire and also met its commitment to prevention and preparedness through the preparation of the WTA-FPP. The IMT assisted the Police Arson Squad with their investigation of the cause of the fire and DEC has cooperated to the maximum extent with their subsequent investigations into all aspects of the fire.

The DEC accredited fire investigator was called for by the SDO on Saturday 29 December and he conducted his investigation on 30 December. His report concluded that *'due to no evidence being found at the point of ignition to prove the cause being either deliberate or accidental, the cause of the fire remains undetermined.'* Whilst this is the proper formal investigation conclusion, it is reasonable to speculate that the fire was indeed caused by someone lighting a fire, possibly some form of campfire. This kind of activity is known to be common in such roadside stopping sites. It is likely the perpetrator either abandoned the fire or lost control of it and fled the scene. A broken branch found at the scene may have been used in an attempt to beat the fire out. DEC is not aware of any witnesses who saw the initiation of the fire and therefore has no basis for further action in pursuit of the person/s who started the fire. In view of the circumstances of the fire, DEC has deferred further investigation of the cause of the fire to the police Arson Squad.

DEC's FOG 52 contains procedures for managing suspected deliberately lit wildfires, and the Department's Wildfire Cause Investigation Manual contains specific detailed investigative procedures and reporting requirements. Wildfire cause investigations are scaled up according to the significance of the incident. The priority actions are to investigate as early as possible whilst the evidence is fresh, and to protect the evidence from any disturbance. There is a requirement for reporting Phase 3 Investigations (the highest level) to the police with the assistance of the SDO. Ideally the first officers arriving at the origin of the fire should protect the site from disturbance, but in this case it was late afternoon, the officers did not have the means of sealing off the entire roadside parking area and were understandably focused on doing an initial assessment of the fire

and making a report to the IC. They then concentrated on arranging the OP and further checks on the progress of the fire into the evening. The best and most realistic time for the fire cause investigation of the point of origin would have been early on the morning of Saturday 29 December in response to the status of the fire as a level 2 or level 3 phase investigation. It is not uncommon for fire cause investigations at DEC fires to occur a little after the initial burst of activity during the fire escalation phase as fire fighters and IMT leaders are doing many high priority strategic actions that can have a significant bearing on the outcome of the fire. The strong DEC culture of putting the fire out rather than finding out who or what is to blame tends to place an instinctive premium on suppression actions. Nevertheless, as the SDO's action attests, DEC staff understand that a fire cause investigation is an important procedure and DEC's training of DOs, ICs and IMTs does emphasise the requirements of FOG 52. DEC will give additional attention to this in training and briefing sessions.

In retrospect, given the situation of a bare and highly trafficked parking area, it is unlikely that even the earliest possible investigation would have come to a more conclusive finding. DEC awaits the Arson Squad findings on the cause of the fire and will respond to any comment or advice given on future fire cause investigation procedures.

Recommended Actions

1. DEC will continue to give emphasis to the requirements contained in FOG 52 in the training of DOs, ICs, IMTs and SDOs.

2. FOG 52 will be reviewed to see if any improvements are needed or any triggers require cross referencing with other initial fire assessment and resource dispatch guidelines.

3. DEC will continue to participate fully in the standing Bushfire Arson Investigation Team to ensure effective inter-agency collaboration to reduce the incidence of arson in Western Australia.

3.6 Fire Assessment and Appreciation

3.6.1 Declaring Wildfire Levels

Debrief Issues

It was noted in debriefs that the classification level of the Boorabbin fire was not formally declared in the first three shifts, but was intuitively assessed by the IC and the SDO who responded accordingly. In fact the response was in excess of the traditional deployment to a GFR fire reflected in the WTA-FPP. When the fire escaped to the south across the GEH on 30 December the IC and SDO decided that further resources were needed to cope with what they knew to now be a Level 3 incident, albeit undeclared. The arrival of the additional IMT resources, including a Level 3 IC, the next morning, was considered practical and appropriate to the immediate and expected overnight situation.

Coordination Group Review and Discussion

Fire Protection Instruction 83 (20/02/2006) Declaration of Wildfires (later FOG 83) sets out the procedure for making a declaration about the classification of a fire as a Level 1, Level 2 or Level 3 incident. The levels are described as follows:

Level 1 – a minor incident; able to be managed by the District Duty officer utilizing District Resources; likely to be resolved in hours.

Level 2 – will require a number of local resources; will draw DEC resources from outside the District, could involve one or several agencies; probable that more than one (24 hr) shift will be required to resolve; will need to be managed from an incident Control Centre; will require the deployment of a Pre-formed Team (Short Team or a Long Team).

Level 3 – a major incident; will involve many resources; will require an extended period of time (days or weeks) to resolve; will need to be managed from an Incident Control Centre; will require the deployment of Preformed Team (Long Team).

These classification definitions are in line with the national AIIMS approach to classifying wildfire incidents.

On detection, the District Duty Officer is required to classify every fire. Any Level 1 incident involving the deployment of suppression resources will be notified to the Regional Duty Officer. Any incident classified as a Level 2 or Level 3 incident will be notified by the District Duty Officer to the Regional Duty Officer immediately. The Regional Duty Officer will notify the State Duty Officer of any Level 2 or Level 3 incident immediately.

The DEC RDO at Kalgoorlie notified the SDO of the fire, via the afternoon telephone conference, and imparted its significance in terms of requirements for suppression. This action met the requirement of FPI 83 in terms of timely advice to the SDO but there was at that time no considered classification of the fire as one of the three levels. The response by the SDO in organizing the supply of fire fighting resources was consistent with a L2 incident and in fact exceeded traditional practice with GFR fires. The escalation of the response to the fire when it escaped across the GEH on Sunday 30 was consistent with a Level 3 incident that it undoubtedly was at that time, although there was no formal declaration of the incident moving to Level 3.

A debate arose during the debriefs and during Coordination Group discussions about the correct classification of the Boorabbin fire based on its potential, as required by FPI 83. Most agreed that the incident was never really a Level 1 as it was recognized at the outset by the RDO/IC that local resources could not deal with it and it would become large and require sustained additional resources from outside the GFR. Some thought it migrated from a Level 2 incident on Saturday 29 and to a Level 3 incident on Sunday 30 when it

broke away to the south across the GEH, whilst others said it was always a Level 3 incident from the outset based on its total potential to be a large and sustained fire suppression campaign. The potential in terms of its threat to the GEH and important adjoining assets also influenced some opinions towards the highest classification although FPI 83 is based on difficulty of suppression rather than assets at risk.

These difficulties in fire incident classification arise because there are some inadequacies in the FPI itself but also because of the special nature of GFR fires compared to those classified in the South West forest regions where the classification system is most commonly applied. Once GFR fires escape into expanses of fire prone landscape they will become very large and require considerable resources from outside the GFR to achieve suppression, if containment is pursued. For example, the Holland Track fire in the GFR burnt for a month in December 2006. So, it would be a reasonable default presumption that any fire escaping into shrubland vegetation in severe weather conditions will be a Level 3 incident, until and unless it can be shown that it will inevitably be constrained to a smaller size by the contingency of being contained within low fuel areas. It is evident from the Boorabbin fire declaration experience that FOG 83 (previously FPI 83) will have to be adjusted to give SDOs and ICs guidelines that can accommodate marked regional differences in fire potential.

Quantifying the 'potential' of a fire with reference to fuel and weather may take some time and so initial declarations may have to be made subjectively and conservatively.

The purpose and scope of FPI/FOG 83 also bears examination:

FPI 83 says *'the declaration of the status of every wildfire enables decision makers to maintain their situational awareness, set meaningful priorities for response, respond in a timely manner with sufficient resources and activate predetermined response actions.'*

Thus FPI 83, perhaps ambitiously, sets comprehensive expectations from fire declarations that goes beyond resourcing a response as it also aspires to impart *'situational awareness'* and fire *'status'*. There are many pieces of information required to fully and reliably assess the potential of a fire; including the fuel, topography and access, the weather, resources available, other fire demands, effectiveness of suppression strategies, assets at risk, people at risk, environmental values etc. All of these inputs are also necessary to maintain situational awareness at the district, region and State level delivered in ways appropriate to the tactical and strategic responsibilities of each level of assessment and decision making in DEC. The fact is that FPI 83 was primarily designed to trigger a suitable and timely organization and dispatch of resources to an incident, particularly when it requires additional resources from outside the district or region containing the fire. The classification of an incident does impart a cryptic concept of the potential size and complexity of a fire, and therefore constitutes a general warning or alert to the Department, but does not necessarily say anything about the significance of the associated threats or risks, particularly in relation to assets.

DEC's CLM 660 Initial Fire Report is a form designed to capture information about fire occurrences into the Department's fire records system. It also serves to inform the Regional Duty Officer within 15 minutes of the report being compiled that a fire is currently occurring. In practice it is often accepted as a phone call from the DDO to the RDO with the paper version going to the Regional Headquarters fax machine for the record. The Initial Fire Report records initial basic information about the fire such as the location, land tenure, resources dispatched, area burnt, vegetation affected, apparent cause, dispatch of water bombers, fire behaviour assistance required and estimated time to control. This information is essential for the first assessment of the fire and must be accurate, particularly the location of the fire. However, it does not attempt to classify the fire, or estimate its potential, although in the hands of an experienced Duty Officer, it will provide the necessary information so he/she can to go about assessing the potential of the fire through other means. The Initial Fire Report is entered into DEC's Fire System prior to the close of business each day and this keeps the system up to date and ensures fire information is not lost. The Fire System uses this data and the Final Fire Report (Form CLM 304), along with any other information produced during the management of the fire to produce fire statistics and other fire information useful for fire prevention, preparation and planning.

AIIMS also provides a checklist going by the acronym SMEAC that covers the overall setup of a fire organization. SMEAC stands for Situation Mission Execution Administration Command and Communications. On the face of it, it would seem ideally suited to be an initial fire report, fire appreciation and fire status document. However, as it is really only made possible from the work of the IMT after some time has elapsed and the many facts it contains have been determined it is not available at the start of a fire. SMEAC is simply a disciplined way of delivering a briefing during a fire, typically in the field, and does not play a part in the initial assessment of the fire.

The IAP contains a very comprehensive process (AIIMS) and set of IMS forms for assessing the existing and potential status of an incident by quantifying the assets at risk, predicting fire behaviour from physical parameters and thence working out the suppression forces required. In theory, this system (or selected parts of it) can be used as an initial fire assessment procedure, but in traditional practice it is used by an IMT to plan and prepare actions for the next shift. The first edition of the IAP does not usually appear until after the first shift and therefore is not normally used as an initial strategic fire assessment tool by the DDO, RDO, SDO or IC. It certainly becomes the all encompassing strategic fire appreciation master plan for everyone when available.

DEC Duty Officer Role Statements (FOG 80) and Checklists (CLM 289, CLM 237, CLM 203) describe and list the functions and actions of the SDO, RDO, DDO including the management of wildfires. At the three levels of responsibility and oversight, duty officers are all required to keep a check on fire status, threats, commitments and any damage from wildfires. These objectives are achieved through direct and indirect contact by phone, email and fax and by various reporting procedures. It usually operates through a chain of communication and command. All Duty Officers are expected to be familiar with all of the liaison and reporting procedures and supporting technical guidelines, such as those

described above. The Role Statements describe the function, knowledge and skills needed whilst the Checklists give a list of actions to 'check off' as appropriate to the circumstances. They are not intended to be a 'formula' but certainly assist duty officers to keep track of their duties. As such, they do not give exact specifications about the strategic or tactical assessment of wildfires.

As can be seen from the brief review of the initial fire classification and reporting system elements described above, there is no one trigger mechanism or definitive action sequence that spells out the procedure for determining the status of an incident, it is a combination of these mechanisms joined with experienced judgement and decision making. This is reflected in the experiential qualifications stipulated in the Role Statements, for example, Level 3 IMS experience for the SDO. The subject of IMS qualifications is dealt with later in this report. In practice, the key duties of each Duty Officer's role is served by the dialogues that occur between the Duty Officers in the early stages of the fire. In some cases, as happened at Boorabbin, these dialogues may be shared with other team members, such as during the daily Duty Officer telephone conferences. The outcomes of these dialogues are seen in the actions and documented procedures left in the incident records and in the diaries of the individual officers.

In reviewing this topic, the Coordination Group has come to the realization that whilst all of the essential details needed for a Duty Officer or IC to assess the potential and declare the status of an incident are captured in the various existing procedures, they are not fully integrated and coherent at the start of a fire when needed most, and some, like the IAP, are not available until the fire is well developed. The existing system tends to concentrate on the rapid dispatch of incident management personnel (IMT) and fire suppression resources (trucks, crews, machinery) as the main priority, and it does this very well, as exemplified by the Boorabbin fire response, but it may often be the case that the dispatch is founded on a quick judgment of the potential of the incident rather than an early systematic assessment of the parameters of the incident. This approach is well recognized in DEC as a traditional way of ensuring a rapid response, as it is better to reduce an oversupply of resources than having to belatedly supply more if the fire was underestimated. Officers, particularly less experienced Duty Officers, are often counselled that they will never be criticized for sending too many resources, but may be at fault for sending too few. This approach also recognizes that when a fire breaks out there is usually little information available, but key decisions still have to be made. This issue can be particularly acute in remote regions like the GFR with relatively small staff numbers, especially fire staff, and the RDO has to do most of the initial fire assessment and response functions himself before backup staff can be found.

It is apparent to the Coordination Group that the standard guidelines and procedures that serve to notify and classify an incident in the initial stages need to be reviewed and improved, particularly for application in remote regions such as the GFR. The initial fire report, the incident classification system, and components of the ICS fire appreciation and situation analysis need to be combined at scales of complexity and in timeframes that really do achieve the assessment of *'fire potential'*, *'situational awareness'* and fire *'status'* that FPI 83 intended. To do this FPI 83 Declaration of Wildfires, FOG 80 Roles

and Responsibilities of Rostered Officers and Duty Officers, with attendant Checklists (CLM 289, 237, 203), and CLM 660 Initial Fire Report will need to be reviewed and integrated or cross referenced as appropriate to make sure the early stage assessment of an incident is sufficiently strategic to reliably determine its status. It is expected that the early use of the Situation Analysis components of the IAP (IMS) will be instrumental in ensuring that assessment is founded on a systematic appraisal and presentation of the information available to DOs and the IC. To achieve this, the IAP Situation Analysis forms and work flow will be reviewed with an emphasis on the essential hinge points and timeliness. The aim will be to facilitate a concise rendition of the key information, identify decision points and produce a map depicting the fire potential.

The Coordination Group recognizes there are three stages of fire status assessment in the first one or two shifts. The first is the initial report and rapid assessment and response that can be so critical to the success of early fire containment. Improved initial fire declaration procedures will be put in place but this phase will continue to be partly founded on the instinctive judgment of the duty officers and the traditional culture that it is better to overdo a response than underdo it, subject of course to other fire priorities. The second phase is the early part of the first shift wherein the RDO and SDO have time to make further enquiries, seek additional information and advice and place the fire in a strategic regional and Departmental context, considering the fire danger ahead. It will depend largely on an active dialogue between the IC and Duty Officers, assisted by the IMT when in place. The standard guidelines and procedures (improved versions) will give depth to the assessments by the passage of reports and maps and commence the documented record of the fire. The third stage commences when the IMT is able to produce an IAP. The IAP is also the medium for predicting future major changes in the fire. The subject of improvements to the IAP is discussed separately.

Recommended Actions

1. FOG 83 will be reviewed and modified to further emphasise the strategic assessment of fire potential and other risks posed by the incident and the formal declaration of fire status at the earliest phase of the fire, with reassessments at appropriate junctures during the fire. ‘Potential’ and ‘risk’ will include all values that might be impacted.

2. Other standard guidelines and procedures that have some bearing on the declaration and recording of incident status will also be reviewed and coordinated with FOG 83.

3.6.2 Strategic Appreciation of the Fire

Debrief Issues

A range of views was expressed in debriefs about the strategic assessment of the fire with respect to assets at risk, the location, potential size of the fire, and the adequacy of a ‘normal’ response. There was some debate about what was conventional or normal in the

traditional GFR fire culture and experience. GFR fires are characteristically started by lightning in remote areas with few built assets and most are simply monitored until they self extinguish against areas of low fuel such as salt lakes or woodlands with little ground cover. In more recent years DEC's GFR has mounted fire suppression operations with its limited resources including two fires (2005 and 2006) that actually impacted on the GEH and another two (1998, 2001) that were adjacent to the GEH. Fire planning and fire mitigation works exemplified by the WTA-FPP is a relatively recent innovation.

Large wildfires in mallee heaths in the Midwest Region and South Coast Region have given south west forest based fire crews and IMT staff some valuable experience of these fast moving extensive fires in areas with few roads or fire control features. Not many DEC fire management staff have experience with GFR fires, although there are similarities with the two regions mentioned. Consequently there is a variety of knowledge, experience and expectations about what is a normal response to a fire in the GFR, and usually a deferral to local experience in making that judgment.

This incident suggests that DEC should review its strategic assessment process for wildfires in remote regions where the staff and resources available might require assistance to determine the most appropriate level of response and to ensure the progress of the IMT is monitored and supported.

Coordination Group Review and Discussion

A debrief comment raised the question of the adequacy of the strategic appreciation of the fire. It is perhaps the most generic question that can be asked.

The Coordination Group has found that the answer to the question is multifaceted and has to be explained and understood in several contexts.

All fires are strategically assessed at their beginning and usually at other times during their development. At the least, the IAP is designed to give the IMT and the SDO a thorough fire appreciation and projection for each shift. More informal assessments and appreciations are made between issues of the IAP. One way of deconstructing a complex strategic fire appreciation process is to break the fire into stages or phases as follows:

Stage 1 Fire North of GEH

On Friday December 28, with south east winds predicted and many kilometres of shrubland fuels ahead, it was correctly assessed by the IC and SDO that the fire would be large, but reasonably safe for traffic on the GEH. The forecast wind change to the north east and north west on Saturday evening and Sunday morning would bring the fire back to the GEH if not contained by then. Containment north of the GEH seemed possible and became the prime strategic objective. This fire appreciation and response was also strategic in that it gave effect to the preplanning of the WTA-FPP for the area including the Boorabbin National Park. The IC, SDO and IMT were fully aware of the strategic significance of the location of the fire next to the GEH and enveloping the 'lifeline'

services corridor adjoining the GEH. The safety of firefighters and traffic on the GEH was seen as paramount as confirmed by briefings given to fire fighters and the advice the IMT gave to police and MRWA contractors of the need for road management. Initially this was suggested as police patrols and later as roadblocks. The hazards were clearly identified in the IAP produced on Saturday evening. This confirms that the IMT had a strategic appreciation of fire behaviour and its potential to put smoke over the GEH, affect traffic with direct fire and cause traffic accidents. The IC issued media releases warning of the traffic hazards in the vicinity of the fire. The fire suppression strategy indicates the IMT understood the nature of the fire and correctly identified the only safe way to tackle it.

Officers were observing fire behaviour on the ground and from the air and therefore had a sound idea of the rate of spread, flame height, fire intensity and likely extent. They also had a good idea of the fuels ahead of the fire and the probable behaviour of the fire in those fuels. Strategic expectations of fire scars (previously burnt low fuel areas) were not always realized and some areas that were expected to slow or stop the fire did not. Although this was something of a warning that the strategic assessment of fire progress might need adjustment, the IMT still placed expectations on fire scars, such as the one on sector C that they joined with a fire break. This was in retrospect still a reasonable strategic assumption. At the end of Saturday 29 fire containment lines extended 12 km to the north on sector A giving the IMT a factual account of the strategic position they had achieved. The completion of the fire containment line on sector C was correctly seen as the most strategic objective for Sunday before the strong northerly wind change arrived. In the event, this strategic objective was achieved, but not the desired result, as the fire escaped.

The escape of the fire had been strategically assessed and was known to be a distinct possibility with the predicted weather conditions, but the IMT anticipated, with some justification based on the previous day's achievements, that they might hold sector C and attain their overall strategic objective of keeping the fire from threatening the GEH or escaping south of the GEH. In the event the severe conditions, particularly wind strength, overcame their defences. The single blade width convoluted fire break was unable to hold such fire behaviour and crews could not contain numerous hop overs. The IMT is given credit for trying to stop the fire on sector C, as an escape of the fire to the south would greatly extend the fire area and would jeopardise the GEH. This decisive plan was executed with commendable safety preparations and precautions that in the event were needed.

Stage 2 Breakout to the South of GEH

As previously mentioned, the possibility of a fire breakout (a worst case scenario) was anticipated and was a disappointment when it happened, but not a surprise. Strategic thinking was evident when the IC notified Macmahon that roadblocks might be needed and when the breakout occurred they were put in place, with the police again participating. The OO suggested to the IC and gained his approval for the additional defensive strategy of using the grader to clean up a secondary containment line north of

the pipeline as well as cleaning up the old containment line around the 1998 fire scar. The IMT was aware that they might gain a strategic advantage from the wind backing around to the west during Sunday that would blow the fire edge on sector C back on itself and back towards the previous northern run of the fire situated to the east. This possibility was not realized as the fire breakout was almost immediate when the northerly wind got to full strength quickly in the morning and the fire scar ahead of the fire did not stop it. Unfortunately the fire hop over penetrated the narrowest section of the fire scar and threatened the GEH immediately beyond it. The anticipation of assistance from the westerly wind change would only have worked if the fire could be contained by the fire break or the fire scar until the change arrived as predicted at 1900 hrs and unfortunately that objective was not achieved.

The critical strategy was to keep the fire north of the GEH, and all efforts were focused on that objective. The PO and OO were mindful that this strategy might fail and had conferred that should the fire cross the GEH they would simply let it run south and then take stock of the situation. Although this was not a detailed plan for another possible phase of the fire it was a realistic scenario as they knew the fire would be intense, fast moving and unstoppable and would require the same patient pursuit with direct flank attack that had already been used north of the GEH. They were also aware of the presence of salt lakes and fire scars to the south of the GEH. In a sense, it would simply be more of the same with the notable complication of managing the traffic on the GEH, that they had already recognized and taken initial steps to organize.

Stage 3 Highway Management

Direct suppression measures were untenable as the fire ran rapidly south of the GEH and were also inhibited by the OO's concerns about the safety of fire fighters from downed powerlines. In these circumstances the DEC resources gave priority to assisting the police with the management of the GEH. Whilst the IC and IMT had shown situational awareness and foresight in anticipating GEH road blocks and alerting Macmahon and the police, there was as yet no detailed plan in place to manage the GEH in the longer term. In retrospect this was a deficiency in the strategic longer term assessment and planning of this aspect of the fire. The IMT responded correctly in accordance with FOG 75 by notifying the MRWA contractors and police, helping them set up road blocks and continuing to assist with communications, liaison and convoy duties, however they did not make sure that the control centres of the road and traffic authorities were advised, and did not pass that duty onto the SDO. The SDO and IC discussed the impact and significance of road blocks on such an important State transport artery, but the DEC central control system did not initiate State level agency liaison, presuming that the local management was best suited to manage the road blocks. It seems that the local regional road and traffic authorities and police did not trigger any notification or response from their central systems, or if they did, the result has not become evident to DEC or in actions at the fire. DEC's Principal Communications Officer based in Perth who was drafting media updates on the fire for the IC, did pass the approved 1200 hrs media update to the MRWA in Perth at 1338 hrs on Sunday 30. Although this is not the same as

a formal notification or referral through the IMT – SDO channel, it did provide the MRWA with the essential information about the road blocks and fire situation.

It is conceivable that a regional level approach to GEH management that employed suitable strategic planning would have worked but in hindsight the more advisable and conventional approach would be to involve a parallel process in the central control centres of each organization. The local formal mechanism for this is the establishment of an OAMG and an IMG. The IMT did not recognize or take the opportunity they had to call an OAMG or IMG when their lesser measure of inviting police attendance at IMT meetings was declined. The notable exception was the early and persistent presence of a local FESA liaison officer who proved to be helpful and active in several operational aspects of the fire. The SDO did not prompt the IC to call an OAMG, because he thought the road management process comprised a simple total road block, which although a serious inconvenience and cost to transport on the GEH, was considered to be relatively simple to undertake and possibly of short duration. There were elements of an IMG in the form of infrastructure agencies such as Western Power liaising with the IMT, but this fell short of a properly convened and coordinated IMG.

In retrospect there was an obvious lack of strategic assessment and appreciation of the management requirements, logistics and complexities of installing, maintaining and lifting road blocks on such a significant highway by all agencies involved. The static infrastructure 'lifelines' such as power, water, telecommunications and rail line were also a serious consideration, but there was little the IMT could do about these except ensure that there was effective liaison with the infrastructure owners to protect local structures such as power poles and communication towers to the best of their ability. On critical issues like turning power off on downed lines and the restoration of power, there was excellent awareness, communication and cooperation.

The glaring outcome of the Boorabbin fire experience is that all relevant agencies and private companies need to look to better strategic assessment and planning for managing important infrastructure affected by bushfires, and to do so with a common understanding of joint procedures and a readiness to implement them in a timely fashion. This is now happening for road management during bushfires with the preparation of State level Vehicle Control Point Guidelines.

For its part, DEC's FOG 75 was useful but insufficiently detailed and will be improved. The IMT recognized and accepted its role as the HMA decision maker at Boorabbin, particularly with regard to risk assessment that controlled the road blocks. The issue of a strategic assessment and appreciation of this risk occurs in the next stage of the fire.

Stage 4 Overnight Sunday 30

Whereas the wind inflection from the north on Saturday and extreme weather on Sunday morning was seen as the pivotal strategic event in plans to keep the fire from threatening the GEH, the similar situation south of the GEH on Sunday night with a southerly change was not recognized as a critical threat to the GEH. This event was the second strategic

"tipping point" of the entire fire, but was not recognized as such. The essential difference was that the second tipping point occurred at night and was assessed and appreciated through the lens of a predetermined expectation that GFR fires generally become benign at night, this presumption apparently being supported by experience of other GFR fires and observation on the previous day and by direct and supposedly confirming observation of fire behaviour at the time. As explained under several headings in this PIA, there were a number of factors that coalesced with respect to strategic assessment of the fire's potential, technical projection of fire behaviour, planning for traffic management on the GEH and the resources required to deal with all of these challenges simultaneously. All of these issues contained a strategic dimension as well as a tactical operational aspect.

Overall

There were a number of critical strategic events that needed to be assessed and appreciated during the course of the first three days of the fire, simply portrayed within the stages described above.

The IMT developed strategies for each phase of daylight operations of the fire on Saturday 29 and Sunday 30 and recognized the critical 'hinge points' such as the stand required on sector C. The IMT essentially looked at the fire in daytime operational segments, with no overnight shift. The IAPs presented the objectives, strategies and tactics for the next daytime shift. The planning was therefore anticipating conditions and activities one day ahead with an inactive overnight interlude. This methodology is in keeping with the procedures contained in DEC's IMS. In retrospect this approach was not sufficiently forward looking to discern the entire potential of the incident over a number of days and also discounted night time fire behaviour. It is apparent that the IMT were aware of the general potential and behaviour of the fire in that they knew (including IC on Friday) that it would be a typical large GFR fire ultimately brought under control by containment lines and areas of naturally low fuels. However, they did not see the need for an early longer term strategic projection of the fire over the range of the available forecasts that usually cover about four days with reasonable reliability. The SDO appeared to share that view based on the same assumptions about the 'normal' GFR fire.

In hindsight it is possible to propose that a simple strategic analysis of the fire based only on the known fuels in the area, the high temperatures and the wind strengths and directions in the four day forecast would be possible. This would be little more than a simple form of 'vector analysis' of the fire that in effect just plotted the major runs of fire with an estimate of the rate of spread giving the extent of each run. Each fire run would be terminated either by low fuel areas or by a change in wind direction, or both. Realistically any such analysis would probably be done under the auspices of the general expectation of GFR fires that it would probably not progress extensively at night. To make any different assumption, the IMT would need access to a more quantitative and objective process for predicting night time fire behaviour, and that was not available for the GFR. This aspect of strategic planning is dealt with under the separate heading of 'Fire Behaviour Prediction'.

The Coordination Group has reflected on why the simple but telling longer term 'vector style' prediction of fire runs was not part of the substantial planning effort made at the incident on Saturday 29 and Sunday 30. It is also conceivable that it could be made on Friday 28 based on a broad spectrum view of fuels and the wind directions. Characteristically for this incident there is a complex of reasons that combine to explain this question that are addressed in this PIA. However, from a strategic fire assessement and planning viewpoint the main reason appears to be that the IMT saw their planning task as the production of a very detailed IAP for the next shift and the management of the resources and logistics cycle for a conventional GFR fire in single shift mode. The SDO has indicated he also saw the fire in those conventional terms that were thought to be typical of GFR fires with the notable variation that DEC had responded more actively to this fire than any other in the history of GFR fire suppression.

The Coordination Group has questioned whether the limited strategic longer term fire assessment (e.g. four day projection) at Boorabbin is an IMS systems deficiency or a feature of the IMT execution of the system or an aspect of the evolution of the fire suppression program in the GFR?

The Coordination Group concludes that is all three, plus other important contributors dealt with elsewhere in the PIA. Comments on each follows:

With respect to the systems issues, the IMS comprehensively covers all aspects of incident planning, including short term and long term projections. Nevertheless, the system does not really ask the planning officer to make fire projections over a range of timeframes or for different strategic purposes. It is a one size fits all approach that covers the essentials of an Incident Action Plan in all circumstances. The Coordination Group suggests that the system can be amended to mandate longer term fire assessments commensurate with the amount of information available and the point of development of the fire and suppression response.

In terms of the human element of the system, the Coordination Group came to the view that there is a tendency in some IMTs to be fixated on completing the IMS templates and processes so a complete and coherent IAP is available on time for the next shift. Consequently plans tend to be short term and can fail to stand back and take the 'big view' of the incident. One of the characteristics of Level 3 IC's and PO's is their propensity for constantly examining the broad strategic sweep of an incident with an eye to the key issues and fundamental imperatives, particularly those 'over the horizon'. In short, although the IMS can be improved to make longer term strategic planning a more explicit requirement, the heart of the matter is the way the system is appreciated and used in a scalable fashion, rather than it being intrinsically flawed. This is covered in more detail under the heading 'The Incident Management System'. The Coordination Group believes the IMT, particularly the Planning Section, was totally focused on the IAP next shift process and this supplanted the longer term overview. This orientation was also partly imposed by the inadequate resources in the Planning Unit and the multiple functions performed by the Situation Unit on Sunday 30.

The third factor is the state of development of fire suppression operations in the GFR. Fire suppression activity in DEC's more remote regions is very limited due to the great expanses of land, sparcely distributed assets and few fire fighting resources.The GFR fire management program is increasing with additional resources, formal planning and better fire suppression response capacity, including support from other regions. The Boorabbin incident occurred in this evolving fire management environment and benefited from some of the recent innovations such as the WTA-FPP for the land along the GEH between Coolgardie and Southern Cross. It was the most substantial fire suppression response undertaken in the GFR. The management of the Boorabbin incident was also constrained and conditioned by some of the inherent factors that still prevail such as: limited water supplies, long distances, little across country access, very extensive and flammable fuel types, little direct experience of large campaign fires run by PFTs, no prior local OAMG experience, generalized expectations of fire behaviour especially night time fire behaviour, lack of fire research, lack of dedicated fire behaviour guidelines or tables, limited customized guidelines for fire suppression tuned to the peculiarities of the GFR, limited experience of GFR shrubland fires amongst the members of PFTs, limited capacity of the GFR to field their own IMT at level 3 staff competency, difficult access to contractor resources and machinery particularly during holiday periods, and a number of other special factors such as tyre staking and communications that are covered in the PIA. Everyone in DEC, including all officers in the duty roster system, IMTs and PFTs, is in effect on a learning curve with respect to developing fire suppression responses that can deal with all of the idiosyncrasies and underdeveloped aspects of fire fighting in the GFR. In the view of the Coordination Group this context for the Boorabbin incident helps to explain a number of critical and minor issues that affected the conduct of the incident and the tragic outcome. These factors and influences are dealt with individually in the PIA.

The purpose of longer term planning, apart from logistical considerations, is that it allows the possible or potential consequences of the fire to be assessed. The IMT and the SDO felt that the main strategic consequences of the fire would be that it could become typically large, possibly damage corridor infrastructure and block the GEH. In retrospect, it is evident that the strategic assessment and appreciation of the blocking of the GEH was underestimated from the perspective of the management demands it would make on available resources. This was perhaps the second significant strategic planning deficiency, and as has been explained, was a multi agency problem and required a multi agency solution. Had a "worst case" scenario of a protracted fire, likely to make two crossings of the GEH (requiring extended duration of highway closure), been factored into the strategic assessment and appreciation of the fire, it may have become apparent that large accumulations of vehicles stranded in very trying conditions were in prospect. Such a scenario would require a State level coordinated and substantial multi agency approach to resolve.

Although the IMT and other road management agencies had not fully assessed or planned for the potential traffic accumulation problems, they were innovative in attempting to circumvent it by developing the partial road block system based on escorted convoys. Successful convoys combined with what appeared to be a declining fire hazard would give the impression that the acute phase of the traffic problems was abating within a few

hours of its commencement. The risk determination and risk management for these partial convoys is in retrospect a major issue to be resolved through better vehicle control point guidelines. The issue of road management at the Boorabbin incident is dealt with elsewhere in the PIA.

Stage 5 Strategic Appreciation of the Fire After Sunday 30 December

Section 2.7.1 of the PIA describes the strategic appreciation of the fire by the three IMTs that managed the fire for the fourteen shifts after the fatalities occurred. Anyone reviewing the fire might consider the period post the fatalities as potentially instructive about the management of the fire before the fatalities. In brief, the management of the entire fire was a continuum from shift 1 to shift 17 with a normal development of strategies that progressed with the changing circumstances of the fire situation. As the fire escalated so did the response in terms of additional resources, adaption of fire fighting strategies and a more integrated multi agency combined approach. As has been described in the PIA, a proportionate and measured response to fires as they escalate is quite conventional for DEC, and in fact often essential where multiple threats or multiple actual incidents demand either the reservation of resources or their diverse deployment. So whilst the post fatality phase of the fire can be seen as conventional in most respects it was also extraordinary in some notable ways.

The predominant anomaly was of course the shock and dismay caused by the fatalities, and this undoubtedly galvanized the upgrading of the fire response that was already underway when the SDO recognized a Level 3 fire condition on Sunday 30 as a result of the fire breaking though sector C and crossing the GEH. Although the SDO and incoming Level 3 IC (the same person) had already decided to invoke an OAMG, the fatalities automatically triggered a comprehensive response from all relevant agencies driven from the most senior levels. The immediate convocation of the SECG was the preeminent example. Several other elements of the fire management scenario evolved. The risk assessment process for opening the GEH looked to longer term horizons for potential fire runs that might threaten the GEH that included the hitherto unexpected possibility of severe fire runs at night and was also very precautionary about smoke affecting driving conditions on the GEH. The simple reality of fixing the damage to infrastructure also precluded highway opening for the shifts soon after 30 December. Thereafter concern about protecting fire fighters and agencies using the GEH was also an important consideration. It needs to be said that this resolute stand by the IMT to keep the GEH closed, supported by the most senior levels in the relevant agencies, attracted considerable opposition and criticism from GEH users, and was somewhat reminiscent of the pressures applied to the IMT on Sunday 30, but perhaps somewhat more surprising considering the fatalities and the ongoing risk of a much larger fire.

The Coordination Group realizes that it would be natural to see the enhanced response of all agencies after 30 December as largely a reaction to the fatalities. In fact a detailed examination of the operation of the three IMTs shows that the response to the fire was systematic and in step with each stage of development of the incident. The Coordination Group believes that most of what happened at the incident after 30 December would have

occurred in the absence of the fatalities with the initiation of the steadily increasing response already triggered by the SDO on Sunday. The combination of the size of the fire, its continuing threat to vital infrastructure and the GEH and ongoing severe weather conditions would have obligated the scale of response that occurred. One variable that is difficult to determine in retrospect is the possibility of the partial road block system continuing instead of the complete road block actually adopted. On the one hand the IMT and OAMG would have been subject to the substantial public pressure to open the highway and on the other hand would be weighing up the salutary experience of the fire crossing the GEH twice with great ferocity. As it is the HMA's call, largely determined by the IC's appreciation of the IMT's risk assessment, the question remains open in retrospect as FOG 75 and past practice is not definitive. What can be said is the IMT were now in possession of the knowledge that the fire could run at extreme rates of spread both day and night, and could close on the GEH in short measure. In these circumstances a partial road block could only be contemplated when the head fire was running away from the GEH, the weather forecast was favourable and the traffic control mechanisms on the GEH totally responsive and completely reliable. By far the simplest and lowest risk strategy for any IC would be total road closure at the expense and inconvenience of highway users and those dependent on GEH traffic. This would be particularly the case when the IC could hand over most of the road traffic control operation to other authorities.

Note: The five stages of the fire mentioned above do not relate to the stages in the GHD reports.

Recommended Actions

1. Strategic assessments of the potential of all wildfire incidents will be made as close to the time of detection of the fire as possible and discussed by the District and Regional Duty Officers. Dependent on the significance of the fire, the strategic assessment will be discussed with the SDO as soon as possible.

2. The quality, style and timeliness of strategic assessments of wildfire incidents will be commensurate with the circumstances of the fire and resources available. The focus will be on information content and insight rather than presentation quality. It is expected that strategic assessments will move from more subjective judgments in the initial phases of a fire to more quantitative and measured projections and risk assessments as information and resources improve in latter phases.

3. A declaration of the status of each fire will be made in accordance with FOG 83. FOG 83 will be reviewed and amended.

4. DEC's AIIMS/IMS Planning Section documents and procedures will be reviewed to ensure they are conducive to early assessment, appreciation and central reporting of the fire.

5. The function and scope of a DEC Emergency Incident Response Coordination Centre will be examined. Such a Centre may present opportunities for improving the coordination of consultative decision making in reporting, assessing and declaring the status of fires and appropriate responses by DEC and other agencies.

6. Strategic assessments of Level 2 and Level 3 fires will be made at least once per shift and documented on IMS (ICS) forms covering Situational Analysis. Direct communication between the IC and the RDO/SDO to discuss the assessments will be made at least once per shift.

7. Strategic assessments of fires will cover the duration of the long term forecast, usually four days, and pay particular attention to wind direction and fire intensity parameters.

8. Strategic assessments of fires will consider risks to people and major assets as well as the safety of fire fighters and produce key objectives and strategies for protecting these values. Strategic assessments may identify primary objectives that are not about fire suppression. These assessments will be recorded on the appropriate IMS (ICS) form.

9. Formal training programs for IMTs, particularly ICs and POs, will emphasise the importance of the strategic assessment of incidents, the kinds of assessment required and the critical timeframes for these assessments. Preseason training will emphasise the same points.

NOTE: The Coordination Group recognizes that these principles are already part of the IMS used by DEC, but improvements can be made to written standard guidelines and procedures such as FOG 83 and IMS (ICS) forms and a reorientation made that encourages IMTs to use the IMS procedures selectively and flexibly to meet the strategic assessment needs of each incident.

3.6.3 Fire Behaviour Prediction

Debrief Issues

The IMT was aware of fire behaviour in terms of its intensity, rate of spread, flame height and extent from observations reported from the field, and in the case of the IC and OO from their own direct observations from the air on Sunday 30 December. A map of the extent of the fire was included in the IAP on Saturday 29 and Sunday 30. The WTA-FPP also gave a general forewarning of possible fire behaviour in those fuels. The IMT was aware that the forecast for Sunday would produce severe fire behaviour with the possibility of a break out across the containment line on sector C. When the fire did escape on Sunday 30, the IMT was aware that the fire behaviour was too extreme and dangerous for fire crews to attempt any immediate suppression action. So the IMT had a reasonably accurate concept of fire behaviour and fire potential during daytime

conditions, backed up by regular observations of actual fire behaviour. Perhaps partly as a result of this awareness, the IMT, particularly the Planning Section, did not focus on systematic predictions and projections of the fire. The direction of the fire during the day was known with confidence based on the forecast wind directions. Although there was some minor fluctuation in wind strength and direction, the actual fire development conformed to the weather forecast. The IMT planning and suppression strategy was therefore founded on this awareness of the general likely path of the fire during daytime conditions. Night time conditions were expected to significantly reduce the fire's intensity and rate of spread. This accorded with observations in the early evening, particularly around the GEH on Saturday 29 and Sunday 30. The Air Observer in the helicopter also reported diminished fire behaviour along the entire length of its southerly extent, 10 km to the south of the GEH on Sunday. These observations confirmed their expectation that fires in the GFR are largely quiescent overnight. As previously discussed in Section 3.6.2, the IMT was aware of the south west wind shift due on Sunday evening, and the Planning Officer did make incidental mention of the south east flank (sector X and part sector Y) potentially becoming the headfire from a wind direction perspective, but the necessity to test the forecast conditions against any form of quantitative predictive measure was not seen as necessary.

The fact is that the IMT did not have quantitative fire prediction tools that are regarded as standard operating procedure for fire modeling and prediction readily to hand for exactly these conditions. The adoption of a more precautionary risk management approach would have required the realization that the south west wind change would create conditions near or beyond the 'blow-up' fire behaviour threshold. The difference in temperature, RH, dew point and wind strength at the end of an extreme day and compared to the previous night did not trigger a more precautionary approach or awareness of the need to 'calculate' what the fire might do. Instead, the 'standard expectation' of night time fire behaviour was considered manageable. The management response was implemented through a roadblock strategy that placed sentries at each side of the fire on the GEH, who, it was thought, could see any escalation in fire behaviour and block traffic in the '*unlikely'* event that it was needed. The IMT did not predict that the entire south eastern flank would erupt suddenly into extreme fire behaviour with the arrival of the south west wind change. They were certainly not attempting to use a narrow window of opportunity to move traffic across the fire ground before such blow-up conditions were scheduled and expected to arrive, even allowing for the incorrect reading of the wind change information in the forecast.

Although there is no fire behaviour prediction table regarded as standard operating procedure in the GFR, the WTA-FPP that includes the Boorabbin area did contain information pertinent to fire prediction. The WTA-FPP makes general commentary on fire behaviour in the various fuel types and fuel ages that confirms what the IMT observed and knew with respect to day time fire behaviour. This was part of the 'standard expectation' traditionally accepted by experienced GFR officers, and known to the IC, PO and OO. The WTA-FPP also presents an extract from DEC's fire prediction tables for mallee heath fuels for south coast areas (Albany – Esperance) Fire Behaviour Guidelines For Mallee-Heath In Southern Western Australia (updated August 2004). The table

(Table 5 page 31) shows that at low fuel moisture levels (≤ 9%) and 95 percentile weather conditions of 36^0C and 30 km/hr winds the rate of spread of fire in fuels greater than 15 years old can be 5000 metres per hour with fire intensity of 25,000 kilowatts per metre. This is a very fast moving and high intensity fire. Fire behaviour in accordance with this prediction could be expected regardless of the time of day or night the conditions occur.

The spot forecast issued at 1709 hrs on Sunday 30 December predicted conditions of:

1800 hrs: Temp 40^0C, Dew Pt -5^0C, RH 6%, Wind NW 25 gusts to 35 km/h

2100 hrs: Temp34^0C, Dew Pt 6^0C, RH 18%, Wind SSW 30 gusts 45 km/h

Significant Wind Change: S/SW wind change expected at site approx. 1900 – 2000. Gusts to 50 km/h possible.
Wind strength could also drop to 10-20 km/h in the hour preceding the change. Note there is some uncertainty in exact timing of wind change, due to lack of monitoring equipment west and south of Sthn Cross.

These forecast conditions fall within those described by the WTA-FPP and therefore predict a fire rate of spread of some 5000 metres per hour under the influence of the south west wind change. The WTA-FPP suggests that *'although the south coast heath vegetation differs in species composition from that of the study area (Boorabbin), they are not dissimilar in structure and the models applied here are expected to provide a reasonable approximation of headfire behaviour on the sandplains.'*

The IMT at the ICC made use of the WTA-FPP and commented that it was very useful, particularly in relation to identifying assets and values under threat, and nominating who were the managers of the assets. The relatively inconspicuous Table 5 referred to above was not recognized as potentially giving predictive information about fire behaviour that was especially relevant to the night time conditions on Sunday 30. The WTA-FPP was not intended to take the place of a standard operational guideline or procedure (e.g. FOG) for fire prediction procedures in the GFR and was not considered a substitute for them by local staff working with it to implement fire mitigation works programs. The tentative nature of the fire behaviour extrapolation in the WTA-FPP is captured in this concluding remark in Section 8:

"It is a recommendation of this report that, in the future, greater emphasis be placed on recording observations of fire occurrence and behaviour within the study area. This may take the form of a dedicated study, or more simply, anecdotal evidence from those at the fire front. A much clearer understanding of the country that is likely to burn, and the manner in which it burns, is required to make informed planning decisions in relation to fire management."

FOG 16 Fire Behaviour Guidelines For Mallee-Heath in Southern Western Australia is the same fire prediction table quoted in the WTA-FPP based on research done in the

South Coast Region in local mallee heath fuels. The IMT and Planning Section acknowledged in debriefs that they did not refer to this table to predict fire behaviour during the first three shifts of the fire. The main reason was, as previously discussed, that during day time the fire behaviour was directly observed and the direction of the fire self evident. The IMT really only needed to know if the fire was going away from the GEH or towards the GEH to formulate appropriate fire suppression strategies. At night it was both observed and presumed that the forward rate of spread of the fire would greatly decline so that it would not be a significant threat and therefore the question of the need for quantitative planning projections of fire runs and behaviour during the day or overnight did not arise. If use of these tables was standard practice in the management of GFR fires, the Planning Section would have noticed that the extreme conditions in the forecast, when inserted into the table, predicted extreme fire behaviour in those fuels during the evening of December 30 with the advent of the south west wind change. It is evident from this outcome that the mallee-heath fire prediction table is not yet regarded as standard operating procedure for GFR fires, and its use elsewhere in relevant fuels and conditions also requires validation.

Planning Section (Situation Unit) produced a plan of the fire at sometime around 1900 hrs on Sunday 30 for inclusion in the IAP for the next shift (shift 4). It showed the fire location, size and shape and the map title was captioned 2230 hrs. The map was presented on an orthophoto database with a background of static fire predicted intensities based on fuel types derived from the WTA-FPP. This background would be useful for actual fire predictions and the map was captioned 'Predicted Rate of Spread'. However no actual hand drawn or GIS depicted fire location projections were made on this map. It did not project any progress of the fire in relation to the forecast south west wind change. The same map with the same fire status was also presented with a cadastral background and the title caption '31/12/2007 0845'and produced by the GIS officer at 0851 hrs on 31 December This map did not contain any fire movement predictions.

In debriefs it became apparent that other demands and pressures on the IMT and Planning Section contributed to the lack of formally documented fire projections. The escalation of the fire on Sunday 30 and its escape across the GEH, raised the incident to another level of intensity and pressure that the IMT resources struggled to meet. The IMT that might have been a little under resourced on Saturday, but managing, but was under great duress on Sunday after the fire breakout. Also, in retrospect, it is believed that the very thorough and systematic functions and procedure of the IMS (ICS templates and procedures) tended to focus the Planning Section on producing a well documented IAP for the next shift that consumed their energies and resources at a 'process' level. In doing this they were simply complying with their training and the responsibilities of their roles, but in the analytical environment of the debriefs, some participants wondered if the IMS system was being applied in a sufficiently flexible way at the right scale for the changing development phases of incidents. In other words, has the system become too process driven so that some critical and strategic elements of an incident are captured too slowly or in fact missed altogether?

The pertinent example of this issue from the Boorabbin fire is the situation analysis. The IAP system does provide for fire prediction (ICS Form 1.3) as a precursor or component for deriving strategies documented on ICS Form 1.2. However, as previously described, the IMT felt they could determine appropriate fire suppression strategies based on the actual observed rate of progress and direction of the fire during day time hours and did not require a formal computational process through the IMS (ICS templates and procedures) steps. So,whilst it might be a valid criticism that there can be too much focus on IMS processes and timeframes, the bypassing of some elements of the process, such as computational components of situation planning, can also have undesirable effects. The consensus from the debriefs suggests that the AIIMS and DEC IMS procedures are for the most part effective, but their interpretation and use in practice needs a flexible and proportionate response that picks up the individual strategic import and scope of wildfire incidents, especially in the critical early stages. The IMS is intended to facilitate this, not impede it, so the debrief suggestion is to review the IMS processes in terms of the way situation analysis is conducted, particularly in relation to the IAP.

Managing the under resourced roadblocks was also a key focus for the IMT that added greatly to the demands on their time and detracted from the processes and business of fighting the fire. An example of this was the multiple functions allocated to the Situation Officer who was engaged in liaison and information functions regarding the roadblocks as well as helping to compile the IAP. That is not to say that the roadblocks were not a critical part of the fire; they were, and were treated as such by the IMT, but their under resourcing, and lack of clear procedure, added heavily to the work load of the Situation Unit and more generally the workload of the IMT.

Coordination Group Review and Discussion

It emerged in debriefs that one of the most critical causal factors contributing to the fatalities and outcome of the incident was the expectation that the south west wind change on Sunday evening would not markedly affect the fire development and certainly was not seen as a risk that blow-up fire behaviour might occur. This expectation was founded on two inputs; the experience of key members of the IMT that heath and scrub fires peak during the day and die down overnight, and the observed behaviour of the fire on the previous two nights and early Sunday evening that apparently confirmed that previous experience. The IMT knew that the dominant weather parameters driving scrub and heath fire propagation were wind strength and fuel dryness working together, and knew that reduced overnight fire behaviour is usually also a result of both factors declining overnight (fuel moisture rises, wind reduces). It was not recognized that the resurgence of wind would be accompanied by continuing dry fuel conditions comparable to day time conditions and therefore there would be nothing stopping the fire from resuming extreme fire behaviour comparable to the peak of the day. The technical parameters that predict night time wind strength and fuel dryness in the Spot Forecast at 1709 hrs on Sunday afternoon do not of themselves automatically inform the reader that it equals extreme conditions and blow-up fire behaviour unless it can be interpreted by fitting it into a spectrum or matrix of known fire responses. Scrub and heath fuel moisture levels create marked differences in fire behaviour with threshold values needing to be

exceeded before the wind effect takes over. For example, a trigger point for active fire behaviour in mallee heaths of about 9% (or less) fuel moisture content will produce a variety of fire intensities, rates of spread, onset and duration for various combinations of wind speed and air temperature. The forecast conditions on Sunday 30 at 1900 hrs were about (subjectively interpolated between 1800 hrs and 2100 hrs figures) 36^{o}C, -2^{o}C dew point, RH 10%, 30 kph wind speed, which give an approximate rate of spread of the fire in excess of 2500 m/h with an intensity of about 20,000 kW/m and a flame length between 8m and 14m. The actual weather parameters at the nearest weather station at Southern Cross at 1900 hrs were close to those predicted with values of 40.2^{o}C, -0.3^{o}C dew point, 8% RH, 37 kph wind speed. The higher temperature may have been influenced by the mass of existing hot air being driven back over the fire ground before the cooler southerly air mass. These figures indicate that the traditional expectation of quieter fire behaviour overnight would not prevail in these extreme conditions in the early part of the night on Sunday 30.

Fire managers use two methods to determine when these thresholds are crossed and trigger an alert.The first is experience. An example is that officers that have served in the south west forests for many years are intimately familiar with the combinations of fuel types and their moisture contents that produce reasonably predictable fire behaviour under various weather regimes. They have personally experienced a great number of fires, seen them in the field, seen them plotted, done post incident analysis and had the benefit of sharing these experiences with other staff. The other method is to use quantitative measures to 'calculate' how a fire will develop. On a daily basis south west forest officers have access to computed fuel moisture projections (Surface Moisture Content, Profile Moisture Content), continuous actual weather readings, general and spot forecasts, a calculated fire index and fire behaviour tables to make workable predictions about how a fire will behave, particularly how fast it will spread, how intense it might be and where it might end up. In practice the two methods team up – experience and technical quantification.

The Boorabbin IMT members are fire practitioners with experience in both environments, the south west forests and the Goldfields, but they could not readily exptrapolate their extensive south west forest experience to the Boorabbin environment with respect to fuel types and fire behaviour, and their local GFR experience was limited in terms of the number of fires attended, their exposure to overnight fire fighting, and the limited fire behaviour prediction tools available. Their experience of making technical decisions about fuel moisture affecting fire behaviour in GFR mallee heath fuels overnight was virtually nil. Instead they had some experience of fires that were predominantly tackled during daylight, creating an expectation that fires essentially ran to a diurnal pattern, except as some noted, *'in extreme conditions'*. The problem was, as just described, that the forecast did not trigger the realization of *'extreme'* conditions being reinstated with the south west wind change.

The IMT was in receipt of the BOM forecast Fire Danger Index in the 'extreme' range on Friday 28, Saturday 29 and on Sunday 30 (actual duration of extreme conditions was 0940 hrs to 1940 hrs on Sunday). The IMT and fire crews were only too aware of the

extreme conditions they had experienced all Sunday in terms of a temperature that reached a maximum of 45.2^{o}C at Southern Cross, wind speeds around 35 km/h gusting to 55 km/h and the fire running at several thousand metres per hour. The Spot Forecast offered some relief overnight as Relative Humidity was predicted to rise to 45% at midnight and keep rising until morning but the beneficial effect on increased fuel moisture would be offset to a significant degree by a slow decline in temperature and the maintenance of "high" fire danger by the persistence of 30 km/h winds with gusts to 50 km/h possible. The cooler southerly winds were to bring better conditions on Monday with a minimum Relative Humidity of 20%, a lower maximum temperature of 32^{o}C and reduced winds of 25 km/h.

There were several problems for the Planning Section in interpreting these conditions and making fire predictions.

The first was that on the face of it they had weathered the worst of the extreme conditions during the day and the forecast indicated moderating conditions overnight that might, in the normal course of events, be expected to diminish fire behaviour, and indeed appeared to be doing so as evening approached. The BOM records show that the Fire Danger Index was at 'extreme' until 1940 hrs, when it presumably then dropped to 'very high'. However, the interpretation trap in this trend was that a slot of at least very high fire danger would still exist when the south west wind change occurred because of the time taken for the transition from hot very dry air and strong gusting winds to the onset of cooler and moister air from the south. Also the winds were not forecast to abate to the extent that they would definitely not drive a scrub heath fire, in fact they were predicted to gust with the south west wind change. This danger zone was not fully appreciated by the IMT as the three hourly Spot Forecast parameters were not seen as especially exceptional and the Significant Wind Change in the Spot Forecast was not recognized. In fact conditions were exceptional and described in the BOM post fire report as *'the FDI ranking in the top five for the longest duration of extreme FDI in one day since the Southern Cross hourly data set commenced in 1999'*. Also *'the maximum temperature of 45.2^{0}C at 1650 WDT is the third highest December temperature ever recorded at Southern Cross since observations started in 1908'*. These historically extreme conditions were experienced during the day, but the late maximum temperature indicates that conditions were only slowly abating in the early evening, but signaled to decline markedly with the onset of a sustained southerly wind change. The BOM report says that *'by 2100 WDT the observed southerly winds had reached Southern Cross and were increasing to above 35 km/h peaking at 52 km/h at 2200 WDT. This also brought cooler and more moist conditions, the temperature falling to 27.6C and the humidity rising above 40 per cent by 2200 WDT'*.

As with the IMT, the danger and threat to the GEH cryptically contained in the spot forecast was not picked up by the SDO and therefore not referred to other fire expertise in DEC. The SDO realized that the fire had escalated beyond the capabilities of the resources available to the IMT and had implemented a conventional remedy by recognizing the level 3 status and arranging for the earliest deployment of a L3 IC and an augmented team for the following day. However it was not a direct response to the

indicated south west wind change but rather a reaction to the developing scale and complexity of the fire and its impacts on Sunday afternoon and generally thereafter.

The second problem was the one often repeated in this PIA, that the conditions appeared to be meeting the preconceived concept and experience of what the IMT expected from overnight GFR fire behaviour. This expectation would have disarmed a more thorough analysis of the subtleties within the Spot Forecast.

The third problem was that there was no ready and accepted standard operational guideline or procedure that gave a 'mechanical' or 'process' means of loading the weather parameters into a formula or table that would produce the answer and the warning - *'blow-up conditions'* - in terms of predicted fire behaviour at the time of the south west change.

The parameter that was obvious in the forecast was the southerly change of wind direction that pointed the southeast flank (sector X and part sector Y) towards the GEH, but as it was not expected to be carrying the fire to any significant degree it was not seen as a serious threat. The PO made the observation that a south west wind would convert the eastern flank to a headfire in a directional sense, but in the presumed absence of 'extreme' or 'blow-up' conditions as a trigger to escalate the fire behaviour, and in the presence of comforting confirmation of declining fire behaviour, the wind direction was not seen as a harbinger of danger. With this in mind, the IMT (OO and IC) felt that the sentries on the highway together with the expected convoy escorts would be adequate precautions against the '*unlikely'* movement of the fire under the influence of the south west wind change. However, the slowed run of the head fire to the south east (sector Y) was not just a result of reducing weather conditions but was also due to the fire running into low fuel areas so its forward progress was blocked and the flanks could not develop much under a north west wind. The arrival of the south west wind gave the fire a new impetus, not just because atmospheric conditions had markedly worsened, but also because the approximately seven kilometres of eastern flank was now a head fire on a broad front.

Recommended Actions

1. FOG 83 will be revised using experience from the Boorabbin fire to include more specific guidance on the use and adaption of the South Coast mallee heath fire tables to the mallee heath and shrub fuels of the GFR and the Wheatbelt Region.

2. The WTA-FPP for crown lands between Coolgardie and Southern Cross will be amended to include a more specific reference to FOG 83 and advice on the prediction of fire behaviour in Boorabbin fuels. The same should be done for any other WTA-FPPs produced for remote region areas with mallee heath and shrub fuels.

3. Formal training courses and preseason briefings will instruct IMT staff on fire prediction in mallee heath and shrub fuels over the range of conditions and

regions in which they occur. Formal training courses will present case studies of actual fires in mallee heath and shrub fuels that exemplify state of the art fire prediction procedures and techniques.

4. IMT staff will be required to make fire behaviour predictions in a number of timeframes each shift that allow the IC, RDO and SDO to make timely strategic assessments of the potential of the fire.

5. DEC will develop guidelines for minimum staffing of the Situation Unit at Level 2 and Level 3 fires such that the two key tasks of the SU, namely preparation of an IAP and critical predictions of fire behaviour, are adequately resourced.

6. Protocols for the transmission, receipt, consideration and interpretation of weather forecasts at the ICC and the OP will be implemented.

7. A disciplined and detailed consideration of the forecast for every shift and each substantial change in predicted weather conditions will be established as a formal requirement of the IMS.

8. The presentation and consideration of actual fire behaviour and predicted fire behaviour will be a standard agenda item for IMT meetings.

9. DEC fire research scientists, along with FMS senior staff, will review current knowledge of fire prediction in all regions with reference to past and recent fires and identify priorities for further research and adaption of existing knowledge to fire prediction, particularly for remote regions with developing fire management and response regimes.

10. DEC fire research scientists and FMS senior staff will examine the outcomes of the Bushfire CRC research program (Project FUSE) from South Australia to evaluate their application to fire behaviour in similar Western Australian shrublands.

3.6.4 Adequacy of Resources Allocated

Debrief Issues

Some debrief participants felt that more fire suppression forces (fire trucks, dozers, front end loaders) were required on the first two days to achieve containment of the fire. However, IMT leaders say they had enough fire fighting resources and point to the containment line constructed on Saturday 29 December that almost met their objectives. The delay in the arrival of crews from Kalgoorlie on Sunday due to travel distance and the temporary stranding of the crew transport bus at the OP the previous evening was also raised. There was a view that the fire breakout south across sector C and the GEH is not attributable to the length of containment line produced (related to number of resources)

but rather the ability of the containment line and attendant fire crews to prevent extreme fire behaviour crossing the existing fire line. Most felt that it is unlikely that more crews could have prevented the numerous hop overs from escaping, and it would have been dangerous to continue to attempt to do so in those conditions.

The number of fire suppression resources (dozer, FEL, two fire tankers) that could have been deployed in series as a working unit on a direct flank attack was limited by the lack of access tracks in the Boorabbin vicinity.

Fire crews and staff from south west forest Regions were unaccustomed to not aggressively chasing a fire at night, but had to accept that it was not practical to safely construct secure containment line at night in those conditions. Some south west fire staff also thought that the resources were a little light-on for the size of the fire as they are not accustomed to fires spreading at such speeds as a routine event and are accustomed to employing substantially more resources on fires with such potential. By the same token they are not accustomed to large fires self extinguishing in low fuels or the strategies that go with that experience.

This debrief discussion points to the need for DEC to review fire suppression strategies and tactics that can be employed in these fuels, fire hazards and limited access situations to efficiently construct and hold fire containment lines. Some guidelines on rates of fire containment line construction and the resources needed to reliably achieve them should be produced.

It should be noted that there were no limits placed on the resources available to the IMT. The IMT received all of the resources requested, when they were requested and more were available subject to travel arrangements, logistical constraints, and the unavoidable lag in delivery times to this remote location.

Coordination Group Review and Discussion

The majority view in the debriefs was that the fire was under resourced for the first three shifts regarding fire fighting crews and equipment and also staff for the IMT, particularly Planning Section and Operations Section.

The debriefs did not identify how additional crews and fire tankers would have been used on Saturday (December 29) or Sunday morning (December 30), or how additional fire containment line construction machinery would be deployed to good effect. There were physical limitations as to how many fire units (1 dozer, 2 fire tankers, 1 Sector Commander) could be placed on the fire line in tandem as there were only two access routes crossing the flank of the fire, namely the Merbine Track and the GEH. The same applied to sector C on Sunday. In order to achieve a working space between the units they would need to each start at different points on the fire edge and this was limited by access and safety considerations. It may have been possible to drive units through the burnt area and in effect leapfrog the units, but this was not a particularly attractive option as it still

required some track construction through the burnt vegetation to protect the fire tankers from tyre staking and other damage.

In terms of fire containment line production, the available resources in fact made excellent progress on Saturday and nearly completed the job before the northerly wind change. The IMT was reasonably confident they would complete the containment on Sunday and so there was little evidence that they were in need of critical extra resources and did not ask for more resources on Saturday. The OO did request a bulldozer on Sunday and some more resources for the OP. The OO had it in mind that if the fire did escape south of the GEH a bulldozer would be required for track construction and any scrub rolling that might be needed. The SDO assured the IC that additional resources were available and provided everything that was requested but accepted the general assessment that the existing resources were adequate. The progress on the fire containment line was reassuring.

There was little redundancy or spare capacity on site and so when one machine broke down there was none spare to fill the gap immediately, and this was a reflection of the lack of equipment available from contractors on pre arranged standby and perhaps also a consequence of a major holiday period. In this sense the provision of standby or reserve machinery resources could have been better. The OO adjusted his resources by transferring crews and machines from sector A on Sunday because that part of the fire edge was holding comfortably in the prevailing wind conditions.

The ultimate test of the adequacy of fire fighting resources and fire break construction came on Sunday 30 about 1000 hrs when the northerly wind change gathered strength and tested sector C. The crews were working to complete that fire containment line to an area of reduced fuel in a fire scar to the west and south of the fire as the top strategic priority. In fact the containment line was completed, but the fire broke out across the existing containment line in several places and could not be held by the forces available, and possibly by any number of forces. The fire behaviour was so severe that the crews and machinery had to evacuate urgently to safety zones, and therefore more resources on that particular sector would have simply meant that more had to evacuate sector C. A question remains as to whether the sector C containment line could have been made more resistant to fire hop overs with additional resources to build a wider and straighter cleared break. As it was, the containment line was very convoluted as the crews followed the fire edge closely to avoid leaving unburnt fuel inclusions or inadvertently excluding burning fuel on the wrong side of the break. This pattern is very inefficient and time consuming. The Coordination Group is of the view that the weather conditions were so extreme on Sunday midmorning with matching extreme fire behaviour, that it is unlikely that any amount of resources or any form of containment line construction would have prevented the fire from escaping. However, this is a retrospective view and at this stage the efficacy of alternative styles of containment line in these conditions remains to be tested.

Two things emerge from these reflections:

The first is that the IMT and the SDO thought that the resources provided were adequate at the time and were doing the job satisfactorily. There were more resources available from south west Regions, but they were not called upon for the foregoing reason. In retrospect the Coordinating Group believes this was a reasonable assessment of the situation. The resourcing level was strategically focused on keeping the fire north of the GEH rather than a possible extended pursuit south of the GEH. Excellent progress had been made on fire containment line construction on Saturday. The IMT was correct in assessing that the containment of the fire on Sunday morning against the northerly wind and worsening fire conditions would be the strategic pivotal event and all resources needed to be focused to that end. The strategy encompassed the standard machine blade width fire line that linked with the fuel reduced area of the adjacent fire scar. In effect it was a race to build and hold sufficient fire containment line before the fire escalated. This is a conventional approach and did not seem to be competing with any unusual alternative strategies such as doubling the blade width, chaining and scrub rolling or burning back from the GEH. If other measures were considered they would probably have required additional resources and possibly different equipment. Additional equipment would have had to be ordered on Saturday to arrive for an early Sunday morning start, and at that stage the need for it was not apparent, despite the unexpected run of fire from the fire origin to the north west that changed the strategy for dealing with sector B to a focus on sector C. The OO did foresee that should the fire escape south of the GEH then a bulldozer would be required and he took the precaution of requesting one. The IMT recognized that a fire escape constituted an entirely different phase and expansion of the fire, that would indeed require more resources, but as it would be running away from the GEH into an expanse of fuel, the resourcing issues would be addressed as part of that next phase of the fire, should it happen. When the fire did escape on Sunday morning the IC and SDO decided on a substantial augmentation of resrouces for fire suppression and the IMT with a planned delivery on the following day, Monday 31. The enhancement of resources was not related to any anticipation of the south west wind change being another pivotal event and so the timing of the delivery of the resources was unrelated to that forecast change.

The second point is that there appears to be a need for the Department to closely examine fire fighting tactics and techniques in remote regions in the mixed mallee, heath, shrub and woodland fuels interspersed with low fuel areas such as fire scars and salt lakes. This information is required for the purposes of better calculating the resources required to manage particular kinds of remote region fires. DEC needs to know the following:

- what production rates can be achieved on fire containment lines in the various fuels and how resources on these containment lines can be best utilized?
- whether it is possible to make more effective fire containment lines or fire breaks (eg chaining vegetation)?
- how access can be improved?
- what are the fire fighting safety essentials, for example, how to cope with limited water supplies?
- how to provide for the tyre staking hazard?
- how to maintain or replace machinery?

- how to improve the practicalities of fighting heath and shrubland fires at night?

This list should not portray a serious lack of knowledge about fire fighting in heath and shrubland fuels as the Department has experience of these in recent years in the South Coast Region and the Mid West region, but there is a need for a systematic review of what we know and what we need to know and to set this knowledge out in guidelines and training manuals. This documented information will help to close any gap in experience and knowledge between the crews and IMTs from the south west forest Regions and the staff in remote regions who 'host' these kinds of fires. It is possible that some of the resource observations made by south west Regions fire fighters in the debriefs reflect their different experience with slower moving smaller fires with slower containment line production rates that are very heavily resourced because of the assets at risk. It should also be noted that the WTA-FPP that covers the Boorabbin area is an indicator of DEC's commitment to fire planning and preparation that goes some way towards addressing these issues and might also be a vehicle for the further improvements suggested here.

The Coordination Group agrees with the assessment by the IMT that aircraft water bombers would not be effective on this type of fire as the logistics are prohibitive. The fact that the IMT carefully examined this option, including the use of a local airstrip, demonstrates they were canvassing all options for the best use of resources and were prepared to request them if thought necessary.

It is clear from the debriefs that the IMT did need additional staff resources at several stages during the first few shifts. The Planning Section needed extra staff to help the Situation Officer obtain more fire information and to assist or relieve that individual officer with other concurrent functions such as the liaison and information roles. A skilled GIS officer was also required to produce the high quality maps customarily provided to the ICC and OP. Planning Section was focused on producing the IAP by the time stipulated by the IC. The PO became aware of the additional resource needs and requested some extra support at 1430 hrs on Saturday 29. A GIS officer arrived at 2030 hrs that day. The escalation of the fire about 1030 hrs on Sunday 30 stimulated another realization that a substantial augmentation of the IMT was required and those resources arrived on Monday 31. This arrangement was made before the fatalities occurred and was a response to escalating fire conditions and a new scale of the incident.

The OO noted in debriefs, and the Coordination Group also observed in retrospect, that the OP was under resourced resulting in an excessive work load for the OO and constraints in relaying information on the fire situation back to the ICC. The circumstances at the OP were exacerbated by the very trying physical conditions and rudimentary facilities for fire control operations. Distance also played a part in the late arrival of some staff and the limitation of effective runner dispatch; the journey between the ICC and the OP being a three and a half hour turnaround by road. It would have been a relatively simple matter to augment the OP with additional staff had the need been appreciated early enough. The OO did not directly call for assistance which is a testament to his focus on the task in hand and perhaps also his fortitude and efficiency in dealing with the conditions.

The IMS does partly rely on the IMT making its needs known in good time and in anticipation of future peak demands. Traditionally in DEC, the SDO uses discretion to make independent judgments about the adequacy of IMT resourcing and carefully considers the capability, experience, capacity, roles, functions and numbers of staff needed and provided to incidents, particularly Level 3 incidents. The SDO followed that practice from the outset and felt that a very capable team with relevant experience and sufficient numbers for the task was deployed. The SDO encouraged the IC to ask for more resources rather than less and took the initiative to send some extra specialist resources such as communications and aircraft support. This was a response that exceeded the norm for a GFR fire, partly triggered at the Kalgoorlie end by the WTA-FPP response zoning and partly by the significance of the assets at risk; the services corridor and the GEH. It is a credit to both the IC and the SDO that such an appropriate response was made at the earliest juncture. The IC was acting outside of the normal GFR paradigm by requesting such extensive resources and the SDO was responding fulsomely to what might have seemed like another 'standard' GFR fire running north away from the assets and likely to be arrested by low fuel areas in the usual manner. Activity on Saturday 29 seemed to confirm these settings with a little extra support being provided to specific areas of need in the IMT.

The deficiency in the resourcing process was to not fully anticipate and make more conservative preparations for the worst case scenario of a fire breakout on Sunday, despite the IMT being aware of the prospect. Had this been done, the resourcing schedule may have recognized that Saturday was a critical time to prepare for Sunday and to allow for travel distance and time to reinforce the IMT and crews. From a resourcing viewpoint the IMT suffered from a 'best case scenario', which although it was a considered assessment, did not alert them to the requirement of being fully resourced before the need arose. The SDO was solicitous about providing adequate resources, but did not obtain sufficient information to assess 'situational awareness' to see any flaws in the IMT's optimistic assessment for Sunday's fire conditions. The SDO reflected in debriefs that he would defer to GFR officer's superior local knowledge of fire behaviour in these fuels and had no reason to doubt their optimism that the fire could be arrested, particularly in view of the excellent progress made on Saturday.

The IMT did realize that the worst case scenario would involve the fire running extensively to the south of the GEH and the PO and OO conferred that should that happen their strategy would be to simply let it run its course until it hit low fuels and/or their fire suppression forces could catch up with it. So there was an understanding that the worst case scenario would be another game plan and they would realign their strategies accordingly if and when it occurred. This appreciation did not translate into any contingency plans for major additional resources until the new fire scenario happened. The Coordination Group acknowledges that this kind of reactionary staged resourcing strategy may be a natural characteristic of GFR fire management that has to respond to rapidly spreading fires and is nearly always in pursuit or 'catch up' mode. Once GFR fires have attained a critical size (which they can do very quickly) their control can only be achieved by an alliance with low fuel areas, favourable weather and a substantial

assemblage of resources. The strategic assessment, justification and marshalling of such resources is a new phenomenon for the GFR and for DEC. Gauging the timeframes for control of such extensive fires is also problematic as was demonstrated by the later shifts of the Boorabbin fire.

The Coordination Group considered whether the resourcing issues (raised in debriefs) had any detrimental effect on the outcome of the fire.

With regard to actual fire fighting, the Coordination Group is of the view that the initial fire suppression resources were adequate for the immediate purpose and well used as described above. With regard to the IMT, the Coordination Group acknowledges that IMT performance would have been improved by additional resources arriving early Saturday 29 to support several key AIIMS roles such as the IC, PO and OO, and their Sections. Additional support in the Planning Section with liaison and information specialists would have left the Situation Officer free to concentrate on situation analysis and preparation of the IAP. At the OP additional support staff for the OO would have reduced pressure on that officer, but may not have made any difference to the outcome as the operations functions were in fact well delivered. Perhaps the most notable improvement would have been better transfer of information back to the ICC.

It is not possible in retrospect for the Coordination Group to determine definitively how additional IMT staff arriving on Saturday or Sunday might have changed the fire outcome as the extra staff would not necessarily have introduced substantially new inputs to the management of the GEH or fire behaviour prediction. The improved freedom of Planning Section officers to concentrate on these issues may not in itself have changed the outcome and an increased flow of information between the OP to the ICC would not have remedied anything known to have been a decisive problem.

The question of whether Level 3 ranked ICS officers in the IMT replacing the Level 2 ranked officers would make a difference is valid. The brief answer under this Section heading by the Coordination Group is that it might have, but Level 3 officers would still have to contend with the relatively unfamiliar extreme fire behaviour in shrubland fuels, the extrapolation of the out-of-context South Coast Mallee Heath Fire Table, a useful but inadequate FOG 75, and insufficient support from other road management authorities on roadblocks. In these circumstances it is not just the efficiency of execution of the DEC fire management systems that determine the outcome. The fire experience, risk management judgments, leadership skills, communication skills and general wisdom of IMT leaders, particularly the IC, come into play. These attributes do create a difference in seniority between Level 2 officers and Level 3 officers but it is difficult to quantify. The simplest account would have DEC preferring to have Level 3 officers running Level 3 incidents and Level 2 officers running Level 2 incidents, but the two systems of fire level declaration and fire officer competency are not actually formally linked in the AIIMS system and in practice are either resolved by the provision of a PFT or by the discrimination and discretion exercised by the RDO or SDO. The experience and judgment of the RDO and SDO is a critical part of the DEC fire system and provides higher levels of assessment of the strategic resource needs of ICs and IMTs.

The SDO and the IMT thought they were matching the numbers and levels of officer qualification and experience to the level (unspoken classification) of the fire at each stage, and thus decided on Sunday when the fire escalated and escaped, to 'upgrade' the classification level with a delivery of the 'resources upgrade' scheduled for Monday 31.

The questions about the adequacy of DEC's fire fighting and IMT resources also apply to other supporting agencies at the fire, particularly those managing the GEH. In retrospect it is evident that on Sunday 30 when the fire escaped across the GEH heading south that the resources available from Macmahon, MRWA and the police were not equal to the task of providing a flexible, robust and sustained management of the roadblocks, particularly partial road blocks. This problem became apparent to the IMT during the afternoon of Sunday 30 when Macmahon staff indicated they could not resource the western roadblock and police indicated they were overtaxed by the situation, particularly in relation to the pressures of accumulating traffic in difficult physical conditions, notable especially at the western roadblock. The IMT responded by requesting more engagement from the regional police authority and ultimately by deciding to relieve the pressure through escorted convoys. (Note: The SO phoned what was thought to be the Regional Office of the police requesting that they attend IMT meetings, but is has since been realized that the call went to the District police office who declined the request as they thought that if they were kept informed by phone that would suffice.) They also put DEC staff in place on the GEH to assist the police. By early evening (1800 – 1900 hrs) the IMT expected that the need for more GEH management resources from other agencies was not as critical because they believed the falling fire hazard would facilitate a simpler and easier convoy system. In adopting this strategy the IMT was making the most of the multi agency resources they had rather than insisting that the other agencies provide more resources as a matter of high priority. They worked through their local networks of other agencies instead of calling for out of region support. The conspicuous contrast between the large number of out of region resources provided by DEC centrally and the very limited resources from other agencies unfortunately did not trigger a persistent and justifiable demand from the IMT or SDO for augmentation of other agencies resources.

In reviewing these decisions, one should keep in mind that the fire escalation happened quickly on Sunday 30 and the IMT were managing an intense and rapidly moving fire. In the course of 12 hours they went through three major changes of strategy, from trying to stop the fire crossing the GEH, to managing an acute danger phase that threatened fire fighters and GEH traffic, to a partial road block convoy system. The pace and intensity of these events meant the IMT were focused on immediate problems and perhaps not as attentive to more strategic issues such as seeking additional resources from outside of the region. The IC and OO who were the key decision makers with respect to calling for resources were fully engaged in operational matters including personal aerial reconnaissance of the fire and so the onus for these crucial decisions fell onto the shoulders of very few people. There was also a history in the GFR of relatively small scale fire interventions with the attendant culture that they usually did not call for substantial out of region resources. This may have been a background influence.

The DEC system that relies on the leadership and fire management skills of a small number of staff in a decision making hierarchy: district – region - Department, may seem somewhat tenuous. However, ultimately fire fighting and incident management is a combination of established systems, teamwork and key decision makers and must operate in real time 24/7 all fire season. This system is typical of hazard management agencies that engage in 'combat' style incident operations. Both RDOs and SDOs must use their discretion in making autonomous decisions or deciding to share the process with others. The process cannot be prescribed by absolute systems procedures. When necessary, the SDO will share situational analysis with the State Operations Officer, other SDOs if available, other colleagues from Fire Management Services for technical matters and to DEC Directors and the Director General when warranted. The Coordination Group believes the fire response system will always primarily rely on the judgment and decisions made by the IC, RDO and SDO, but suggests a review of this process might produce some improvements in the way that situational awareness is garnered and shared. The concept of a DEC State Emergency Incident Coordination Centre might be a means of achieving better integrated and coordinated management of fire assessment and response. The model proposed is modest in its resource demands and aims to improve the dedicated focus of a small number of key fire staff (including the SDO and SOO) on existing wildfire management procedures. It is not intended to become a large centre, heavily resourced with functions that supervene over the AIIMS IMS and the responsibilities of an IC and IMT.

The matters discussed above lead to further questions about the timing and nature of the declaration of the fire level and the strategic assessment of the potential of the fire. These issues are canvassed in other Sections of the PIA.

Recommended Actions

1. IMT staff will be given training and awareness in the special conditions and constraints that apply to resourcing of fires in remote regions. This will be met by improved standard operational guidelines and procedures, preseason briefings and operational experience. Operational experience will be formally captured in After Action Reviews and Post Incident Analysis.

2. Fire crews attending remote region fires will be given training and awareness of the special conditions and constraints that apply to resourcing of fires in remote regions. This will be achieved through formal training courses, by maintaining knowledge of current standard operating guidelines and procedures, all fire fighters being involved in preseason briefings, and crew leaders participating in After Action Reviews and Post Incident Analysis.

3. District Duty Officers, Regional Duty Officers and Incident Controllers will be encouraged to take a considered approach to resourcing remote region fires that meets the special conditions and constraints that pertain to resourcing such fires. The SDO will also be mindful of the special conditions and constraints applying

to resourcing remote region fires and where possible will ensure a sufficient buffer is built into the response, commensurate with prudent risk management elsewhere in the prevailing fire hazard and existing or potential resource deployment.

4. A DEC Emergency Incident Coordination Centre will be evaluated and if feasible established as soon as possible.

3.6.5 Preformed Team Dispatch Criteria

Debrief Issues

There was a strong view expressed in the debriefs that a full Preformed Team should have been dispatched at the outset of the incident instead of the partial PFT that filled the key IMT positions. It became apparent that some parts of the IMT were understaffed on Saturday 29 and Sunday 30, thus apparently supporting the conclusion that the whole PFT should have been sent. Some felt that DEC's experience in recent years suggested that the dispatch system should err on the side of sending full PFTs on the premise that it is better to overdo it than underdo it, noting that financial cost is not a major impediment within DEC, or more widely within Government concerning responsible decisions to resource wildfire suppression. Others believed it is better to have a flexible system that sends whatever part of a PFT fits the individual circumstances of each fire, noting that fires and State wide fire situations are all unique.

It was apparent that the informal 'rules' for dispatching PFTs suffered from various interpretations and served a range of expectations.

Coordination Group Review and Discussion

There was a strong view expressed in the debriefs that a full PFT comprising about 60 staff should have been sent at the start of the Boorabbin fire. A counter view was that the sending of the partial PFT (short team) was appropriate to the circumstances and the individuals were well suited to a GFR fire. Everyone acknowledged that the PFT dispatch practice in the past gave a choice of a partial team or full team, but some maintained that experience had taught the decision makers to have a preference for sending a full team to make sure all IMS functions would be covered. Not everyone agreed. Reasons for not always sending a full team included the need to hold some resources in reserve to deal with fire threats that might develop elsewhere and also the inability of some receiving ICCs to handle the logistics of a full PFT comprising at least 60 staff.

The Coordination Group takes this debate as an indicator of the inherent element of judgment, flexibility and discretion required in tailoring PFTs to the circumstances of individual fires. It also suggests that the standard guideline for dispatching PFTs may need clarification so there is no uncertainty about the formal requirements. FOG 91 Preparedness and Mobilisation of Pre-Formed Teams aims to provide a systematic process to ensure that the duty team is at full strength prior to it coming to duty to ensure

an efficient and reliable call-out procedure. It does not provide any guideline for Duty Officers or Incident Controllers about discretion to use parts of a team or the circumstances where a full team should be employed. The Coordination Group reviewed FOG 91 with the aim of clarifying the 'rules of engagement' for PFTs.

The Coordination Group accepts the comments made in the debriefs and some strong views from within DEC's FMS that the dispatch of PFTs needs to remain flexible and determined by consultation between the ICs, RDOs and SDO. The IC is best placed to know what is required at the incident and the SDO is in a position to weigh up the total fire risk situation prevailing in the State and other existing or likely demands on resources. Practical considerations about the functionality of the many receiving ICCs, their capacity to accommodate staff and the availability of alternative or supplementary local resources needs to be factored into PFT dispatch.

The concerns of those that felt a full PFT should be the default option will be covered in the revised FOG 91 by suitable precautionary advice to decision makers. The precautionary advice will be that if in doubt, or if the local receiving region cannot bolster the partial PFT on short notice (particularly remote regions), then the decision should favour a full PFT. There is also a need to better define any minimum level of resources or team components for particular functions in predictable circumstances.

The question as to whether the arrival of a full PFT in the days before Monay 31 might have made a difference to the outcomes is difficult for the Coordination Group to hypothetically answer. This question has been covered in the broader context of Section numbered 3.6.4 Adequacy of Resources Allocated. To reiterate with more specific reference to PFTs; it is self evident that a full PFT can do more work and handle a wider range and depth of issues than a short team or elements of a team. A 'long team' is usually headed by a Level 3 experienced IC. In retrospect, the Coordination Group believes it would have been better to have sent a full PFT to start work as early as possible on Saturday 29 December, possibly sufficient to also work a night shift to set the fire up for an expected long haul with very important issues to manage such as the service corridor and the GEH. However the Coordination Group acknowledges that this view enjoys the benefit of hindsight and is not a criticism of the decision that was made during the Boorabbin incident as the Coordination Group acknowledges that the IC and SDO adopted a responsible response strategy that escalated in parallel with the demands of the fire situation and was overlain by a scenario where they held a reasonable expectation they could stop the fire prior to it threatening the GEH. Furthermore the SDO believed that any threat to the GEH could be managed to a zero risk by complete road blocks, if necessary. So from the IC and SDO's perspectives, they were responding to the fire in a measured way that actually exceeded traditional practice for GFR fires and had put a suitable team in place matched to the circumstances they were witnessing.

As discussed in other sections of the PIA, the deficiency in this staged response was that it did not take sufficient cognisance of future demands and potential worst case scenarios that might require the support of a full PFT as early as possible. The underestimation of these escalating demands is partly due to inadequacies in FOG 75 that does not explain

all of the processes involved in road management, the apparent lack of complementary procedures in supporting agencies and the absence of any overarching agreed multi agency approach to road management at fires. Another significant influence is the fact that there is a variety of experience amongst DEC IMT members and DOs with managing road blocks, particularly very complex situations involving road blocks on major roads with heavy traffic. Some south west forest Regions have a growing experience of a range of road block situations that include significant roads and substantial disruption of traffic. They have also worked with local road managers, contractors and police in a range of settings. The most notable difference between this experience and the Boobabbin incident is that nearly all road blocks in DEC's south west regions have been total road blocks that completely closed the road until the situation was entirely safe. Partial road blocks are a rarity. There are several other differences, including different fuels, the usually better options for reasonably convenient detours, the risk of overhead hazards such as burning trees and the generally more accessible resources and services. The Boorabbin incident was also at the top of the impact scale as the GEH is the State's most important traffic and freight route. Road blocks should be distinguished from various kinds of warnings (e.g. raod signs) used by DEC and the road authorities to notify motorists of hazardous conditions (e.g. smoke) associated with fires or prescribed burns that do not actually block the passage of traffic.

It is evident that despite considerable efforts by the IMT, including foresight and anticipation of the need for roadblocks, the liaison with other key road management agencies was limited to a local (regional) purview of the nature of the response required. It is debatable whether a full PFT put in place on Saturday 29 or Sunday 30 would have triggered the OAMG mechanism and produced a multi agency traffic plan that engendered sufficient roadside resources. DEC would expect that a fully functional PFT (IMT) would in due course produce a traffic plan and convene an OAMG for a protracted incident, as Boorabbin became, but the timing of these actions are at the discretion of the IC and the PO. Prior to the fire breakout on Sunday the IMT was expecting to be dealing with a three day fire north of the GEH and therefore the local traffic management arrangements might not seem to have needed an elaboration into a traffic management plan or an OAMG. When the nature of the incident changed with the escape of the fire a full PFT was organised for the earliest dispatch. This was a clear recognition by the IC and SDO that more resources were needed to deal with the increasing scale and import of the fire. Unfortunately the tragedy intervened.

A similar line of enquiry produced a similar answer for the Coordination Group with regard to the prediction of fire behaviour. A full PFT would undoubtedly have reduced the pressure of work in the Planning Section and may have given more scope for work on situation analysis, but as discussed elsewhere in the PIA, it would seem that the extra work required on fire prediction was less a matter of PFT resources and more a matter of a preoccupation with the next shift components of the IAP, the assumption of a 'standard expectation' of night time fire behaviour and being beguiled by direct fire observations.

The Coordination Group concluded that trying to make judgments, particularly retrospective ones, about possible differences in performance of a partial ('short') PFT or

a full ('long') PFT and the difference between the qualifications or designated levels of officers is fraught with imponderables as every fire incident presents unique challenges and consequences. What can be said is that DEC expects the PFT system to provide a capacity to match large or threatening fires (Level 2 or Level 3 fires) with an appropriate IMT as determined by the IC and SDO.

In summary, the Coordination Group concluded that the IC and SDO responded appropriately and within accepted DEC practice in sending a partial FPT and stepping up resources as the fire situation demanded. It is noted that the response was more than has been done in the past for GFR fires and included novel elements of extra technical and operational support. At no time was there any constraint on the provision of resources; operationally, attitudinally or financially, and in fact the SDO and State Operations Officer encouraged the IC to nominate whatever he needed and it would be provided.
In retrospect the Coordination Group suggests that the potential of the fire in the longer term was not fully appreciated as it was regarded as another extensive but manageable GFR fire that might have a relatively short duration and only be a problem in relation to infrastructure and the GEH, for which simple zero risk remedies such as total road blocks were available. Thus the progressive buildup of the IMT in stages from a partial PFT that matched fire developments seemed appropriate. The reasons for the under appreciation of fire's potential and consequent under resourcing for a major breakout across the GEH is discussed elsewhere in the PIA.

Recommended Actions

1. FOG 91 will be reviewed to ensure it provides appropriate procedures for the deployment of PFTs.

2. FOG 91 will allow the SDO discretion in determining what elements of a PFT should be deployed to fires.

3. ICs and SDOs will be encouraged to respond to higher order risks with a conservative PFT dispatch (more resources rather than less), commensurate with the overall fire or emergency service demands and risks prevailing or expected throughout the State.

4. SDOs will be encouraged to consult other senior fire staff about the deployment of PFTs when a Level 3 fire incident is likely to develop.

5. Pre season briefings to DOs and PFTs will include an explanation of FOG 91 to ensure there is a common understanding of its contents and intent.

6. ICs will be briefed on the application of FOG 91 and the need for them to specify their IMT resource requirements as early as possible and in the light of worst case scenario planning and situational awareness

3.6.6 Fire Resources Support for Remote Regions

Debrief Issues

It was noted in debriefs that there has been a steady extension of the reach of fire suppression resources based in South West forest regions to the adjoining MidWest Region and South Coast Region, with the Boorabbin fire indicating the trend is extending to the Goldfields and other remote regions.

The Boorabbin fire may be an indication that this trend can be expected to become more demanding and warrants a review of the Department's capacity and systems for responding appropriately in the future. An examination of the strategic position would determine to what extent resource deployment to remote regions can be made more systematic and what limitations are likely to apply. The resource planning aspects of this question also relate to other considerations such as regional incident management infrastructure, accommodation, experience of staff, and managing multiple fires.

Coordination Group Review and Discussion

The debriefs raised a number of related issues concerning the provision of adequate resources to remote region wildfire incidents. Dispatch standing orders, the rules for the dispatch of PFTs, standing orders for Fire Emergency Availability (FEA) in remote regions, the distance constraints involved, and the application of WTAs were all canvassed. This item deals primarily with the first issue of supplying adequate fire resources for remote regions.

The continuously evolving process of extending and improving DEC's fire management and fire suppression capability statewide is highlighted by the Boorabbin fire as it was the most extensive use of out of region fire resources that the GFR has experienced by a large margin and is unique in this respect.

Considering the assets at risk along the GEH corridor and the critical importance of the safety of GEH users, there can be no doubt that the response was necessary, and predictably will reoccur. The evolutionary process that has seen great improvement in DEC's fire fighting responses in the Midwest Region and South Coast Region should now be assessed for the GFR and any other relevant remote regions in the light of the Boorabbin experience. A systematic preplanned assessment rather than an uncertain evolutionary development is called for. It is likely that such a review will identify practical constraints and limitations as well as opportunities for better use of current capacities. A review might also identify new initiatives. Working better with other regionally based authorities and agencies may also be a beneficial outcome.

A looming strategic consideration in this review process would be some consideration of possible climate change, that on preliminary indications might put pressure on the current reach and capacity of DEC's and the State's wildfire fire suppression system. The

drought influence on fire behaviour at the Boorabbin fire might be an indication of fuel conditions that will be more commonly experienced.

It should be noted that the provision of material and financial resources to DEC for fire management and fire fighting was not a factor in the conduct or outcome of the Boorabbin fire. The PIA makes it clear that the issues were about technical fire matters and about fire suppression organization. However, a continuation of the improvements occurring in remote region fire management will require ongoing support from State and Federal Governments as well as improvements that can be made within DEC's existing resources and priorities.

Recommended Actions

1. DEC will undertake a strategic review of the current patterns of demand for fire research, fire management and fire suppression resources in remote regions and determine what priorities should receive attention.

2. Within the context of strategic priorities for resourcing remote regions, DEC will examine what improvements can be made to current fire management systems and arrangements and where appropriate adapt standard guidelines and procedures accordingly.

3. DEC will examine the prospects for benefits from improved mutual working arrangements with other agencies and Local Governments to facilitate joint fire management and suppression initiatives.

4. The strategic reviews of priorities and systems will guide DEC in seeking assistance for remote region fire management and fire fighting from State and Federal Governments through the appropriate protocols.

3.7 Fire Strategy and Operations

3.7.1 Fire Suppression Strategies and Tactics

Debrief Issues

When the fire was reported on 28 December, the IC decided that a sustained direct flank attack was required. This strategy was reported to the SDO and examined several times during the preparation of the IAP on the first three shifts and remained the prime strategy for the entire duration of the fire. The main determinant of suppression tactics was the extreme fire behaviour that dictated fire crews be located immediately next to burnt out vegetation as a refuge should the fire escalate, change direction or start spot fires outside of the boundary. The suppression strategy was determined by the size of the fire, its rate of spread, anticipated long runs and likely major changes of direction with forecast wind

changes. The location of infrastructure assets and risks to people were also considered, resulting in the aim of keeping the fire to the north of the GEH.

On shift 9 Monday 5 January 2008 the IMT applied another fire fighting tactic by chaining scrub fuels along an existing track to the west of the fire north of the GEH, producing a wide zone of rolled scrub that could be burnt as a fuel reduced fire break and defensive line if threatened by a fire run from the north or north west. Sourcing a suitable scrub rolling chain proved difficult. Scrub rolling along the west side of the Duri Track on shift 4 in preparation for back burning with the forecast south east wind was also an addition to the generally applied direct flank attack. This was a form of parallel attack.

Night time fire fighting in these conditions is not practical with existing techniques and equipment as the fire edge cannot be reliably seen and tracked with the consequent danger of excluding hot fire edge or enclosing too much unburnt fire edge that might cause hop overs or be a danger to crews. The general safety of machinery and crews operating in darkness and dust is also a concern. The containment line productivity of crews is therefore reduced to single daytime only shifts.

The extreme heat (at times above 40^0C), exposure to wind (at times 30 kmh plus), sun and flies was stressful for crews, OP staff and those staffing roadblocks. The strategy of direct attack on flanks that were well behind the head fire avoided exposure to the most active and dangerous part of the fire in such harsh and enervating conditions.

A critical element of all fire fighting strategies considered, and the one adopted, was the safety of fire crews. Escape routes and safety zones were planned and used. The OO gave effective briefings on strategy and safety and maintained situational awareness to monitor the safety of conditions. Observers in the helicopter provided effective surveillance of fire behaviour. The IMT (IC and PO) also gave effective briefings to crews. This preparation came into play when the fire escaped from sector C on Sunday when crews disengaged from the fire edge and went to safe areas. The situation was repeated when crews moved from threatened collection areas on the GEH and also when the OP was relocated.

From the debriefs it was evident that actual ‘dead man zones’ were recognized and avoided by crews on a number of occasions.

Coordination Group Review and Discussion

DEC IMTs and fire crews are trained in a number of fire suppression strategies and tactics and must choose which to use in each situation. The strategy of direct flank attack that would eventually catch up with the head fire that was also expected to be arrested by low fuel areas, was in the view of the Coordination Group the appropriate initial choice by the IC, confirmed by the SDO, and reconfirmed at each shift and issue of the IAP for the entire duration of the fire.

An additional strategy of chaining vegetation along the power line and vermin proof fence as a precaution against a third fire breakout across the GEH from the north east on

5 January 2008 was also well conceived. The use of a parallel attack employing scrub rolling along the Duri Track was also a suitable response.

On reflection, the Coordination Group considers there may be other strategies that might play a part in special circumstances in GFR wildfires, such as establishing wide fire buffers, using various forms of indirect attack, fuel modification and burning (commonly called 'back burning' or 'edging' but usually in heath fuels fires can only make progress with the wind, not 'back' against the wind). The application of burning is limited by the risk of fire escape and rapid escalation of fire behaviour in these fuels. It requires a backdrop of reduced or modified fuel such as a chained area, a major road or naturally low fuel area. It also needs suitable wind conditions and fuel moisture content and generally would not work at night. The essential problem with back burning in these fuels and conditions is that the 'back burn' is either too intense or will barely run.

The Coordination Group notes that the IMTs on shift 9 (5 January 2008) did in fact adopt such techniques with a large scale chaining operation along a track to the north west of the fire as a precaution against a new run of the fire. The novelty of these methods in the GFR suggest a more comprehensive review of fire fighting strategies and tactics for shrubland fuels in the GFR should be undertaken. Methods suitable for wildfires might also have application in fire preplanning and mitigation works and could be documented in WTA-FPPs.

Recommended Actions

1. A review of fire fighting strategies and tactics for shrubland and mallee heath fuels in the GFR will be undertaken and safe and effective methods documented.

2. Formal training programs for IMT roles will include coverage of fire fighting strategies and tactics in shrublands and mallee heath fuels. Preseason briefings for PFTs will include updates on fire fighting strategies and tactics when appropriate.

3. The WTA-FPPs for the GFR, and similar regions, will describe approved strategies for fire fighting and for the implementation of fire protection works programs.

4. DEC will investigate the availability or procurement of a large chain for scrub rolling to enable rapid deployment during wildfires as well as increased availability for bushfire mitigation operations.

5. Reliable mapping of low fuel areas (natural, fire scars, woodlands) will be investigated and implemented if feasible as a basis for fire management plans and wildfire strategy planning. A detailed study of remote sensing techniques will be undertaken.

6. After Action Reviews and Post Incident Analysis for shrubland and mallee heath fuel wildfires will review the effectiveness of fire fighting strategies and convert them into operational practice.

3.7.2 Operations Point

Debrief Issues

Koorarawalyee Retreat was chosen on 28 December, with the generous support of the owners (Anglican Church), as the OP by the GFR reconnaissance team, who anticipated the need to set it up at the earliest opportunity.

There was some debate in debriefs about the efficacy of the OP, but there were few options on that long empty stretch of the GEH, and most felt that it was a good choice in terms of its proximity to the fire, the GEH and facilities.

At about 1700 hrs during shift 4 on Monday 31 December the OP was moved to Yellowdine 35.5 km to the west of Koora as the fire threatened to overrun the Koora site. Some OP facilities at Yellowdine were improved by the presence of the roadhouse and parking area. The move was done for safety reasons and not because Yellowdine was superior to Koorarawalyee as an OP.

The severe weather conditions, dust and plagues of flies made the working environment in the OP tent very taxing for the OO and his staff. The generous personal assistance of the owners of Koorarawalyee was acknowledged by the OO and his staff.

Although the site was quite large there were some problems with the manoeuvring of vehicles.

The limited accommodation at Koorarawalyee was well used to eliminate travel time for key OP staff and as it was the only accommodation available on this stretch of the GEH it was a fortuitous choice of site for the OP in this regard.

A comment was made in debriefs that when it came time to relocate the Koorarawalyee OP to Yellowdine there was no documented checklist or guideline to assist in ensuring everything was considered.

The Koorarawalyee OP was conveniently close to the western roadblock so communications were effective, but was 119 km distant from the roadblock at Coolgardie and 89 km from the assemblage of vehicles at Bullabulling.

The helicopter was able to land near the Koorarawalyee OP to facilitate its use by OP staff.

Phone communications from Koorarawalyee were effective, but there was no fax machine on the premises. See Section 3.8.5 for more detail.

Coordination Group Review and Discussion

The selection of the OP can have an important influence on the efficiency of the operations section of the IMT and fire fighting crews. The OP should be well located in relation to access routes, may have to handle large numbers of heavy vehicles, be proximate to the fire but safe from fire danger or smoke, have effective communications, safely manage fuel and other supplies, have power supplies, conveniences and meal facilities and a reasonable working environment for staff. Most of these facilities and services are usually imported, sometimes to a bare natural site, and so the location and configuration of the OP site to accommodate the influx is critical.

Usually there is little time to decide the location of the OP in the initial phases of the fire and it is therefore one of the earliest and most important decisions the IC makes. The IC made a good choice of OP for the Boorabbin fire from his personal knowledge of the facility and the advice of his reconnaissance team.

Any preplanning of possible OP sites in relation to priority response areas or major assets could prove useful and will be recommended in future preseason planning for incorporation in the IPRP.

There was some debate in debriefs about the need to shift the OP due to the potential threat of the fire making a south west run through the OP site, however, the Coordination Group supports the prudent decision of the OO to shift the site to Yellowdine even though it did not necessarily improve the facilities or functionality of the OP.

DEC appreciates the generous support of the owners of Koorarawalyee in hosting the OP and assisting the Operations staff.

DEC acknowledges the fortitude and forbearance of all staff working at the OP in very trying conditions. The OO reported that everyone worked conscientiously without respite or complaint.

Recommended Actions

1. DEC will undertake a feasibility study of portable facilities for OPs and field based ICCs, specifically accommodation (caravans, dongas, shipping containers and tents), a command unit and supporting infrastructure.

2. DEC will consider the organizational, industrial, financial, logistical and administrative issues associated with on site accommodation and long stay facilities at OPs.

3. Additional mobile communication units will be established and deployed to facilitate better communications at OPs in the future.

4. The establishment of large and long stay OPs will be serviced by sufficient Management Support and Staging Area staff.

5. Guidelines for the selection of the OP will be prepared.

6. Guidelines for the planned relocation or emergency evacuation of the OP will be prepared.

7. Preseason planning will include the identification of suitable OPs that will be documented in the IPRP and any WTA-FPPs for high priority risk areas.

3.7.3 Incident Control Centre

Debrief Issues

DEC's GFR office automatically became the ICC. The office is located near the main business district in Kalgoorlie with convenient access to suppliers, contractors, other regional agencies, accommodation and the airport. The office is reasonably large with modern facilities. It is an elongated layout with front street access and limited rear parking. There was a variety of opinion expressed about the functionality of the office as an ICC including some useful criticisms, but mostly IMT members felt it served their purposes quite well.

Administration support and other IMT resources were deficient for parts of the first three shifts until a full PFT arrived on Monday 31 December.

Some standard office supplies and equipment needed to be decisively augmented, such as photocopiers.

The power supply was temporarily lost, presumably caused by the fire cutting or tripping out the 220 kva powerline. Power was also temporarily lost at the OP. The GFR Regional office did not have VHF radio communications at the time of the Boorabbin incident and there are limitations in the use of VHF radios in the GFR.

Some remarks that the elongated dispersed array of office spaces tended to physically isolate IMT functions can be overcome by compensating operating procedures and efforts to ensure adequate message transmission and regular meetings.

Coordination Group Review and Discussion

DEC recently (June 2007) moved to the current Regional Office site and has benefited from a more modern office building and facilities whilst maintaining its convenient

central location in Kalgoorlie. With some minor adjustments the office will serve the ICC function well in the future.

The customary lesson of the need for adequate numbers of local Management Support staff as soon as possible was evident. Likewise local management and fire operations staff were important sources of local knowledge on everything from where to find things in the office to guidance on specific fire management resources. The IPRP and WTA-FPP proved to be informative for IMT staff from other regions. The standard contents and format of these documents facilitates familiar usage.

Arrangements at peak periods should provide for adequate Management Support staff to be available.

The customary minimalist procurement culture of the local staff had to adjust to the high logistical demands and supply requirements of a major fire and the robust acquisition strategies of the experienced IMT leaders, particularly Logistics Section. Having experienced this scale of operation, local staff will prepare stocks of office and fire supplies in readiness for future major fire operations.

Access to existing local computer and IT facilities augmented by personal laptops brought by IMT members is critical for the functioning of the IMT in remote regions.

All forms of communications were available at the ICC, including land line phones, mobile phones, satellite phones, fax, email, web based applications, HF radio, UHF radio. There is no VHF radio system used in the GFR that connects to the VHF system used by visiting fire crews and PFTs. A VHF radio in the ICC might be useful for short range line -of-sight communications to aircraft. Generally speaking, the VHF system would not be an effective means of the GFR ICC communicating with the OP or units on the fire ground.

Recommended Actions

1. The Kalgoorlie Regional office will be permanently set up for emergency power supply connection. Access to an emergency power supply unit will be organized prior to the fire season.

2. A full suite of radio communication equipment will be fitted to the office so all radio bands relevant to fire fighting can be accessed subject to the limitations of the radio range of each system.

3. GFR staff will maintain a stock of office and administrative supplies for support of an incoming IMT as part of preseason preparations. The IPRP will continue to list suppliers of essential stocks, materials and services, particularly contacts for after hours and holiday periods.

4. Similar contingency arrangements will be reviewed for other DEC offices in that could be candidate ICC locations for large incidents.

3.7.4 Fire Operational Guidelines

Debrief Issue

DEC has for some time used a system of Fire Protection Instructions (FPIs) covering a wide range of fire management and fire suppression topics to inform, guide and instruct DEC fire managers and fire fighters. The FPIs are available on the Department's internal website and in hard copy. FPIs have been regularly revised and updated as recommended by DEC fire practitioners and as a result of fire experiences and innovations in fire management. In recent times FPIs were retitled Fire Operational Guidelines (FOGs) to allow for the elements of flexibility, discretion and judgment that are essential for effective and adaptive leadership and response in fire operations. Where the more generic term Standard Operating Procedures (SOPs) is used in this PIA it is intended to encompass DECs FPIs and FOGs including the discretionary subtlety of the guidelines that allows for the unique complexity of every fire. FOGs will continue to be updated and improved and will adopt changes recommended by this PIA and the Findings and Actions report.

It became evident in debriefs that a number of DEC FOGs may need review and revision. Individual FOGs needing attention are discussed in the relevant sections of the PIA. The following FOGs were mentioned in debriefs as possibly requiring review, confirmation, revision or reemphasis:

FOG 03 Minimal Requirements for Incident Action Plan (IAP)
FOG 07 Guidelines for the preparation of Incident Preparedness and Response Plans
FOG 12 Guidelines for Fatigue Management in Emergency Situations
FOG 13 After Action Reviews and Post Incident Analysis
FOG 16 Fire Behaviour in Mallee Fuels
FOG 34 Training and use of Contractors for Fire Control
FOG 52 Suspected Deliberately Lit Wildfires
FOG 59 Dispatch Details for Resources Sent to Incidents
FOG 62 SEMAC Policy Statement 10 – Procedures for Activating State Support Plans
FOG 64 Roadside Signage at Prescribed Burns and Wildfires
FOG 65 Procedure for Walking of Public Roads for Hazardous Tree Identification during Burning Activities and Wildfires
FOG 75 Closure of Roads Associated with Wildfire Fire Suppression Operations
FOG 80 Roles and Responsibilities of Rostered Officers, Duty Officers (DO), Duty Officers in Training (DOIT), and Fire Service Availability (FSA)
FOG 83 Declaration of Wildfires
FOG 91 Readiness and Mobilisation of Pre-Formed Teams

Coordination Group Review and Discussion

The debriefs did not critique FOGs in detail but identified issues that are covered by FOGs or should be included or improved in FOGs. The Coordination Group has reviewed the FOGs in question and the requisite improvements are being implemented with a particular focus on remote area settings. The outcomes are listed in the summary of actions undertaken as part of the Findings and Actions document and discussed in detail in Sections of the PIA that relate to the individual FOG subjects.

It should be noted that DEC's FOGs have been useful guidelines for fire managers based on the Department's experience to date and represent many years of lessons learned from a multiplicity of fires. The list of FOGs above is not intended to imply that they were generally seriously inadequate. FOGs are regularly updated and are always considered subject to improvement as experience and innovation dictate. However, the Boorabbin Fire has revealed that some significant improvements need to be made to some FOGs, with lesser, but useful improvements to others.

Recommended Actions

1. Improvements to FOGs will be implemented as highlighted throughout the PIA and also as described in the Findings and Actions report and as acknowledged in DEC's response to the GHD Operational Review. The review of FOGs will consider their application to remote areas such as the GFR.

3.8 Special Constraints in the GFR

3.8.1 Travel Distance Times to Remote Region Fire Suppression

Debrief Issues

The debriefs noted that an influential dimension of the Boorabbin fire was the long distances to the fire from local regional centres and even greater distances from DEC Regions providing resources. These distances result in protracted deployment times for resources and the need for anticipation of requirements at least one shift in advance.

The IMT and SDO were aware of this special constraint and took remedial actions such as sending specialist expert groups in advance of problems (e.g. communications), sending aircraft for surveillance, accommodating crews overnight en route, and dispatching IMT members on early morning chartered aircraft flights on Saturday 29 and Monday 31 December 2007.

The Logistics Section also dealt with the problem in an innovative way by acquiring provisions such as spare tyres, plant and equipment as soon as possible. The use of a commercial scheduled flight resulted in the replacement IC arriving at 0700 hrs on Monday 31.

Many staff made special efforts to overcome the prominent problem of time and distance by early starts and reasonable finish times.

Distance influenced fatigue management regimes as accommodation was a couple of hours from the fire. Distance was also a special constraint with the management of roadblocks; dealt with separately.

There was a number of mentions in debriefs that the bus transporting staff back to their accommodation in Kalgoorlie on Saturday 29 became stranded on an obstacle at Koora and some thought this delay was critical as it converted to a later rest period and a later arrival at the fire and commencement of work on the fire ground the next day when the fire was at a critical juncture on sector C.

There was also a debate in debriefs about alternative accommodation options at Coolgardie or Southern Cross and whether there had been a better choice or trade-off between the quality of rest and the time available on the fire ground. There was no commercial accommodation (e.g. hotels) available in Southern Cross on Saturday or Sunday nights but through persistent efforts the Logistics Section found a mining camp near Southern Cross that was opened for some the fire fighters and this enabled them to be closer to Koora than a Kalgoorlie billet. There were not many beds available in Coolgardie so the Logisitics Section thought it preferable to take crews a little further to Kalgoorlie to keep groups together and have more choice of facilities. The LO looked further afield to places such as Koolyanobbing for accommodation. There was some selection of who went to the venues closer to Koora, such as machine operators.

There is a considerable difference in logistics and travel arrangements for single shift fires (daytime usually) and double shift fires (day and night). Overlap is possible on double shifts whereas single shifts may be more time critical in terms of operational time available on the fire ground. This was a factor at the Boorabbin incident.

Although the debriefs indicated that overall problem of distance was well managed, it serves to remind us that distance and travel times should be recognized as a special constraint in remote region fires and IMTs trained to allow for it.

Coordination Group Review and Discussion

The Coordination Group notes that the Duty Officers and IMT at the Boorabbin fire were aware of the distances and travel times involved in resourcing the incident from other regions and also from the ICC to the OP. They managed the logistics associated with these constraints well.

Traveling crews on Friday evening with an overnight rest stop en route is an example of the well considered decisions made by the IMT. The use of aircraft to ferry staff was also an effective use of available transport modes. Accommodating crews and staff at Koorarawalyee maximized the time key staff had on the job. The IMT struck a balance

between fatigue management and time at the fire by accommodating most staff and crews at the Southern Cross mining camp and Kalgoorlie. The Coordination Group feels this was a well justified decision considering the extreme heat and long travel distances that fire crews were subjected to.

Reliance on commercial commuter flights can be problematic if they are heavily booked as the replacement IC found on Sunday evening (December 30). The availability of private charter aircraft can also be limiting due to increasing use of charter aircraft by the mining industry.

Long travel distances and protracted times particularly to and within remote region fires can affect the strategy for resourcing an incident and the risk management measures adopted. ICs and DOs might need to be somewhat precautionary in erring on the side of sending more resources early in the incident rather than less if the fire prognosis warrants. The SDO has to consider the fire hazard and fire commitments elsewhere in the State, being mindful that the travel times for recovering resources from a remote region incident is similarly time consuming. The most critical judgment call occurs at the outset when the provision of sufficient resources might actually arrest the fire and prevent it becoming much larger. This situation may be quite different from the sustained campaign fire where the resources are already at the incident and are largely being recycled.

The current resources dispatch system (FOG 59) relies on the IC and DOs conferring about the distances, times, preferred route, rendezvous point, who to report to, communications channels, and any food and accommodation provisions en route and any other relevant matters. The outcome of these arrangements are captured on FPI 59a, 59b, 59c and transmitted to the ICC. In the IMS system, IMS (ICS) forms 3.1 and 2.5 register and track the resources. The process includes the estimation of travel time and arrival times.

The debriefs did not identify any problems with the dispatch system per se despite the long travel distances. Issues associated with the timing of upgrading of resources for the IMT or in the field relate more to strategic decisions about predicting the demands of the incident rather than the contingency of how long it takes to get them to the incident.

Nevertheless, the Coordination Group will take the opportunity to review the initial fire reporting and assessment procedures and documents to see if any improvements can be made to the prediction, calculation and accommodation of distance and time for supplying resources to the early stage of a remote region fire. The IMS makes adequate provision for it in the IAP, but it is the initial and immediate follow-up responses that this issue is mostly focused on. This special constraint of remote region fires will continue to be emphasized in training of IMT and DO staff.

With respect to the specific incident of the bus getting snagged and the consequent delayed arrivals of crews and some staff at the OP and forward deployment to sector C, it is the Coordination Group's view that although somewhat disconcerting for the OO, in the event it would not have made any difference to the critical escape of the fire on

Sunday morning. The reasons are explained elsewhere in the PIA in relation to strategic planning and fire fighting tactics. In brief, it is considered, within the limits of being retrospective, that the timing or quantum of resources on sector C was not material to the escape of the fire as it was a function of the extreme weather conditions and the extreme dryness and flammability of the fuel.

In retrospect, the Coordination Group believes the distance issues were recognized by the DOs and IC and managed well. The distance problem was also influential with respect to fatigue management, physical connections between the ICC and the OP, logistics and supply, use of aircraft, communications, affects on road traffic management and possibly affected the provision of support by other agencies. These are discussed separately.

Recommended Actions

1. Resource dispatch procedures (such as FOG 59) will be examined to see if the distance factor is adequately covered for remote region incidents.

2. DEC will examine the practicalities, costs and staff issues associated with portable accommodation facilities that can be located closer to the OP and fire ground to reduce travel times and decrease dependence on scarce or unavailable local accommodation particularly in remote regions.

3. IMTs will be encouraged to review their requirements for remote region incidents and to conduct post incident analysis of special issues that arise from their experience with distance and time in remote region incidents they attend.

4. The special conditions relating to distance to remote region incidents will be emphasized in DEC fire training courses for IMT leaders and DOs.

5. IPRPs will note the distances and travel times to remote region fire areas to assist resource logistics calculations.

6. Improved arrangements for reliable availability of charter aircraft will be sought for the peak fire season period.

3.8.2 Use of Aircraft

Debrief Issue

Charter aircraft were used to transport incoming IMT members from south west locations. This is the fastest means of delivering staff to the fire direct from their local areas and allows them to have some overnight sleep and preparation time. Scheduled commercial flights do not always have available seats and also require time and transport to reach major airports. An example is the lack of available commercial flights for the incoming L3 IC until Monday morning 31 December. The limitation of baggage (25 kg

limit) on small chartered aircraft was seen as a problem for staff wanting to bring more gear for their fire roles.

The SDO took the initiative to send a helicopter with an experienced Air Observer to the fire. The helicopter was used by OP staff to personally reconnoiter the fire and at other times to obtain reports on fire behaviour from the Air Observer. The helicopter was instrumental for observing fire behaviour near the GEH and advising the OO when it was safe for escorted convoys of traffic to be released from the roadblocks and pass through the fire zone. This service was only available during Visual Flight Rules daylight hours with 1900 hrs the latest departure time from the fire.

The IC used a light aircraft for a reconnaissance of the fire on Sunday 30 December. This was the aircraft hired by DEC for ferrying staff and materials to Kalgoorlie.

The use of water bombers was thoroughly considered by the PO and the helicopter was used to assess a local airstrip near the fire area for their use, but it was decided that water bombers could not be logistically supported and would in any case be ineffective on such a large and fast moving fire.

Coordination Group Review and Discussion

The use of aircraft at the Boorabbin fire was well conceived and executed.

The SDO exercised commendable initiative and foresight in sending the helicopter and experienced Air Observer to the fire at an early stage.

The use of chartered aircraft to ferry staff to remote region fires has become standard practice in recent years and is an efficient way of getting people to fires with minimum fatigue and maximum time on the job. A limitation is the volume and weight of gear that can be carried in light aircraft. DEC will examine how this might be supplemented with parallel ground support or other means. Charter aircraft are sometimes difficult to engage at short notice especially during periods of industry wide full capacity. Preseason assessment of the availability of charter aircraft appears to be necessary.

The Coordination Group agrees fully with the assessment of the PO and the IMT that water bombers would not be effective at incidents like the Boorabbin fire.

The departure of the helicopter from the fire ground just prior to the fire escalation with the south west wind change on Sunday evening was significant as the AO platform had proved very effective in monitoring fire behaviour and guiding traffic through the fire zone on the GEH. The unavoidable departure of the helicopter at what turned out to be near the critical moment that the fire escalated begs the question of the feasibility of extended night time air operations. Extended night operations of manned and unmanned aircraft for intelligence gathering or surveillance at fires will be investigated. The

prospect of night time aerial fire mapping has been studied by DEC, but will be reviewed for its application to situations like the Boorabbin fire.

The Air Observers noted in debriefs that the helicopter did not have effective radio communication with the ICC and was compelled to use a mobile phone for Search and Rescue (SAR) notifications. This is also noted in the Communications Section of the PIA.

Recommended Actions

1. DEC will continue to use aircraft as effective tools at remote region fires for transport, intelligence gathering, safety procedures, monitoring of fire behaviour, transport to and around fires and communications between the ICC and OP.

2. Aircraft operations for fires are effectively managed through the considerable air work experience of Fire Management Services Branch and supported by the AIIMS functional structure of an Air Operations Group under the command of the OO. These practices are already effective and will continue to undergo development and improvement in the future within the overall DEC aviation management arrangements.

3. DEC will look into the availability and condition of strategic airstrips in remote areas, particularly those near likely OPs as part of preseason preparations and updating of IPRPs.

4. Complementary modes of transport will be used to overcome load limits on ferry aircraft, such as follow-up ground support vehicles.

5. Improved radio links to aircraft working at remote region fires will be put in place wherever technically possible. Conventional SAR procedures will continue to be rigorously used.

6. It is not envisaged that water bombers will be deployed routinely to GFR fires as they have for the South Coast Region and the Mid West Region. The use of water bombers, especially for asset protection, will be assessed on a case by case basis.

3.8.3 Use and Availability of Water in Remote Region Fire Suppression

Debrief Issue

The Goldfields Water Pipeline running parallel to the GEH had no hydrants or standpipes that could be used to refill fire trucks at the Boorabbin incident. A large water storage tank near Koora filled from the Goldfields Water Pipeline was accessed for water. A water tanker was hired from Kalgoorlie and used to refill fire trucks.

Bulldozers on fire containment lines had to be protected by two fire trucks so one would always be present when the other replenished its water tank. The construction of cleared earth fire breaks along the flanks of the fire reduced the amount of water required to a minimum. This is standard practice in such conditions, termed 'dry firefighting techniques'.

Fire fighting strategies in remote regions are often constrained by very limited water supplies. This special condition requires dry fire fighting techniques to be deployed and will influence fire fighting strategies, fire equipment quantity and type, expectations of containment line production and time for fire containment. It may also influence the measures adopted for the safety of crews and they way that they operate on the fire line.

Questions were asked in the debriefs about preplanning to access water supplies such as Water Corporation tanks and pipelines or private industry sources.

Coordinating Group Review and Discussion

The IMT was fully aware of the limitation on water supply on the fire ground and adopted appropriate fire fighting tactics to deal with it.

They were also aware of the need for crews to be working adjacent to the refuge of burnt ground on the flank fires and for escape routes to refuge collection points as a precaution against fire escalation, rather than depend on copious water supplies for protection.

Pre season planning should include an examination of possible sources of water across the region, but particularly in high priority zones such as along the GEH. The findings can be captured in the IPRP and in WTA-FPPs where appropriate.

Preplanning might also identify large water carrying tankers from various sources such as mine sites, industry or Shires that can be accessed opportunistically or preferably by prior arrangement.

Strategic access and information about fuels is critical to successful 'dry' fire fighting.

Recommended Action

1. Training of IMT members and fire crews for attending remote region fires will include dry fire fighting techniques that work with limited water supplies.

2. Safety awareness training of IMT members and fire crews attending remote region fires will include advice on safe operating procedures that are not dependent on water supplies. The customary safety procedure of never pumping tanks empty will continue to be emphasized.

3. The establishment of water take-off points (hydrants/standpipes) at key sites along the GEH water pipeline will be investigated.

4. Preseason planning and preparation in remote regions with limited water supplies will identify and organize access to whatever water supply infrastructure and plant is available. This process will include large water tankers and access to more hydrants off the GF pipeline if cost effective. The measures will be documented in the IPRP and WTA-FPP where appropriate.

5. Maintenance of a strategic network of access tracks in trafficable condition is essential for gaining access to fires and for developing strategies that use existing fuel types to advantage.

6. Reliable information on the condition of fuels is required to plan fire suppression strategies that make full use of low fuel areas and facilitate dry fire fighting techniques.

3.8.4 Vulnerability of Tyres

Debrief Issue

Truck tyres were subject to staking from the sharp stems of vegetation severed by bulldozers on fire lines and from burnt vegetation stems shaped and hardened by the fire into spear-like hazards. The problem became acute and threatened to disable vehicles as they used up their onboard supply of spare tyres. Logistics Section urgently supplied tyres from DEC in the South West Region as they were not available locally, the limitation no doubt exacerbated by the holiday season.

This is a serious problem as it can incapacitate fire fighting appliances and equipment and could conceivably put them, the bulldozers they protect, and their crews in harms way.

It is recommended that in future GFR fires, vehicles, particularly fire fighting tankers, be supplied with a sizable cache of spare tyres at the outset.

Coordinating Group Review and Discussion

DEC has an excellent standard of fire fighting equipment and vehicles backed up by a very competent Fleet Section who were able to promptly supply the requisite tyres through the Logistics Officer. However the problem was not anticipated and so trucks did not come prepared for the high incidence of staking. This experience is now a ‘lesson learned’ and a mobile cache of tyres will be ready for the next fire season.

Recommended Actions

1. A supply of tyres (a cache) will be available within DEC for automatic dispatch to similar fires in the future. Both heavy and light vehicles tyres will be included.

2. DEC training of Crew Leaders, SCs, OOs and LOs will include the Lessons Learned for remote region fire fighting, including the risk and implications of tyre staking.

3.8.5 Communications in Remote Regions

Debrief Issues

DEC's remote regions such as the GFR use UHF and HF radio channels that do not require a network of 'repeater' towers to provide effective coverage. South west Regions use VHF radio channels that only have 'line of sight' transmission and reception and only operate over extended areas like a fire ground where there is a repeater station network strategically located on high ground (or towers) within line-of-sight of transmitting and receiving stations or vehicles. The south west Regions are almost completely covered by a VHF radio repeater network and therefore VHF radios are their main means of fire ground communication. When fire units from south west Regions attend fires in the GFR their VHF radios cannot communicate with GFR mobile units or GFR offices as the UHF, VHF and HF systems are not compatible and south west Region units do not have HF radios. Also, the south west Region units attending the GFR have only limited capacity to talk to each other in the absence of a repeater station network and can only use unit-to-unit close proximity communication channels (the simplex system). This meant that initially the GFR and south west crews could not communicate with each other by radio. This was probably not very significant as there were only a couple of GFR vehicles in the field. Of greater significance initially was the lack of an established VHF network in the area to enable radio traffic between VHF equipped units over the whole fire ground and especially with the OP. Also, radio traffic between the ICC and the OP was limited to the few GFR HF equipped units at the fire. The partial solution to the problem of communicating around the fire is to bring in portable VHF repeater stations and distribute them to achieve the best coverage possible over the fire ground. This was done progressively and was a workable partial solution but was affected by another problem, excessive ambient temperatures that caused the repeaters to fail at times.

The lack of VHF at the ICC meant the helicopter could not use DEC Standard Operating Procedures (SOP) for Search and Rescue (SAR) via the radio system and instead used text messaging by mobile phone that is suboptimal. The helicopter still operated SAR watch in compliance with CASA regulations through processes provided by Air Services Australia.

A local FESA communications trailer (ex Northam) equipped with a VHF repeater and portable VHF radios was set up early on 29 December and provided VHF communications between fire units (duplex system) equipped with VHF radio sets. This enabled units on the fire ground to talk to each other and to the OP through the repeater or when out of range of that to each other in close proximity on simplex. A second DEC mobile VHF repeater was set up on the afternoon of 31 December when the FESA VHF

repeater was threatened by the main hop over traveling south towards the highway. Portable radios were distributed to some vehicles that did not have VHF sets. Portable radios at the OP were running off battery packs that kept going flat and the problem was overcome when a 240 volt/12 volt converter from the mains supply was installed.

DEC sent specialist communications staff from Perth and they assisted the OO with communications at the OP by installing the second VHF repeater and fixing the battery charging problems.

Extensive use was made of mobile phones as there is reception along the GEH. Charging mobile phones was a problem due to a lack of chargers. A landline phone at the Koorarawalyee Retreat with a portable handset was a reliable alternative to mobile phones. The landline became the main communication between the ICC and OP and survived a power outage by the expedient of using an old direct handset in the building until the portable handset could be restored. Satellite phones were available to Sector Commmanders and Divisional Commanders but not used and there were some difficulties with a lack of information on their operation. Until Monday 31 December there was no fax machine at the Koorarawalyee Retreat or available as part of DEC's OP equipment.

An observation was made at debriefs that it might have been useful for DEC to have access to UHF Channel 20 (also called Citizen Band radio (CB)) that is used by truck drivers as this would have enabled direct communication with them. The DEC GFR vehicles have UHF radios and other agencies at the fire might also have them. The south west Regions vehicles did not have UHF radios and are not generally accustomed to using that system to talk to other CB users regarding wildfires or other incidents. A DEC fire crew gathered at the gravel pit fire refuge point on the GEH (north side) just east of Koora some time after 2000 hrs when the fire had engulfed the GEH, overheard UHF radio traffic from the radio of a light vehicle parked at the gravel pit. The radio traffic was from truck drivers within or near the fire zone further to the east talking about turning their trucks around and sounding stressed. DEC staff say that the indications from the UHF radio traffic was that these truck drivers were alright as they had FESA and police personnel with them. It does not appear to be the case that DEC staff actively used the few UHF radios available at the scene to actively communicate with the truck drivers for convoy management or to assist in the management of the crisis period when the fire crossed the highway on the evening of Sunday 30. The PIA process cannot determine if the FESA officer or the police used UHF radios to talk to truck drivers at this time. They were not asked to do so by the IMT.

The OO, and officer assisting the OO, had brought their laptop computers to the OP and they were used to communicate with the ICC by email and to access the web for forecasts. The laptop computers used a Next G card to connect to the mobile telephone network. This enabled the transmission of emails between the OP and ICC. Mapped outlines of the fire from the helicopter reconnaissance were downloaded from the PDA/GPS to the laptop and transmitted from the OP to the ICC by email. The OP also emailed some photos of fire behaviour to the ICC.

Planning Section felt that the information flow between the ICC and OP was at times less than they needed to develop the IAP and associated situational awareness, but this may have been more a result of under resourcing the liaison roles between sections and the very heavy work loads, particularly of those at the OP, but also in the ICC. The best source of information on the location and progress of the fire during the day is the Air Observers. This information is physically transferred to the OP and ICC when aircraft land. There was no means of directly transferring this valuable intelligence from the Air Observer in flight except by verbal description, usually with reference to common maps.

A specific issue that caused some concern in the debriefs was the transmission of the Spot Forecast from the ICC to the OP on Sunday 30. It was discovered during the debrief process that the forecast the ICC sent to the OP via email was the District Forecast not the more detailed Spot Forecast. The IMT thought they had also sent the Spot Forecast to the OP via fax machine, but were surprised to learn that there was no fax machine at Koora on Sunday 30. The spot forecast (dated 5:09 Sunday 30 2007) was also emailed from the ICC and arrived at the OOs email address at 2156 hrs on Sunday 30 2007.The OO saw it the next day. It would have been possible to obtain the spot forecast by accessing it directly on the BOM or DEC FMS website from the OP as it was posted. The OO made an effort to access the spot forecast on the BOM registered users website but was unable to find it. The delay in accessing the spot forecast directly at the OP was no doubt a function of the limited support staff assisting the OO and the constantly heavy work load on all operations staff.

Although there were some limitations in the absence of a full suite of communications devices and facilities, the IMT did not feel that their ability to pass essential messages was critically compromised or that it greatly affected the main outcomes of the fire, including the issue of the delivery of the Spot Forecast to the OP.

When the OP was moved to Yellowdine it was found that the VHF reception was out of range of the mobile repeater and failed over half the fire ground on shifts 4 and 5. The coverage worsened as the fire grew larger and fire crews more dispersed. A further two repeaters were set up and an attempt made to link them to create overlapping coverage from repeater to repeater but these efforts were not completely successful with the excessive temperatures causing equipment faults. This was regarded as a potentially serous problem for urgent messages that had to be simultaneously received by all units across the entire fire ground. VHF communications were working within each repeater reception area and so the safety of crews within these cells was not compromised by events within the cell.

Coordination Group Review and Discussion

There was an impression in early debriefs that communications at the fire were a significant problem, particularly the limited radio communication on the fire containment lines and to the ICC. The uncertainty about the dispatch of the spot forecast from the ICC to the non existent fax machine at the OP and the dependency on mobile phones for SAR watch for the helicopter contribute to the picture of inadequate communications. The OO

also had problems logging onto the dedicated email site for his role. The performance of the communication buses and the difficulties experienced by the specialist communications team were further problems. A particularly notable issue was the initial limited use of electronic map transmission. Maps were relayed between the ICC and OP by hard copy, for example those in the IAP. Later some maps of the fire outline were sent from the OP to the ICC by email. The transmission of maps from the reconnaissance aircraft was also done by physical delivery of hard copy or GPS coordinates or by verbal description by phone.

The IMT and the SDO took initiatives to both anticipate and remedy communication deficiencies and these measures progressively took effect. They were supported by the early arrival of DEC communication specialists. The IMT developed a Communications Plan in accordance with standard practice and made it operational by presentation in the IAP.

As debrief analysis progressed, the Coordination Group formed the view, supported by the IMT, that although there were some technical communication issues and better systems can and perhaps should have been put in place earlier at Boorabbin, these were not insurmountable operational problems and did not have a critical effect on the major outcomes of the fire. The key communications device for the Boorabbin fire was the mobile phone and a phone landline, and this enabled the IMT members to conduct meetings and pass essential information. Conversely, the dependency on the mobile phone is also a risk in remote regions and may only be functional along major corridors like the GEH or near towns. The lesson to be learnt from its successful use at the Boorabbin fire is to anticipate that at many fires in remote regions mobile phone coverage may not be available. Satellite phones sent in anticipation of limited communications facilities at the fire were not used but these devices could help to compensate for areas without mobile phone coverage at future fires. Satellite phones operate on individual numbers and are not as effective as a radio network for maintaining situational awareness or sending urgent messages to multiple recipients quickly. It was noted in debriefs that staff from outside of remote regions were not familiar with the use of satellite phones and non standard communication systems and this suggests preparation for remote region fires should include training in their use.

Emails were also used thanks to the availability of the mobile phone network. The OO and his team showed ingenuity in using all the available means of communication and demonstrated foresight in bringing their personal issue laptops, PDA, mobile phones and maps. These facilities were backed up by the FMS Communications Specialist team sent by the SDO.

DEC is generally very well served with fixed and mobile forms of communications backed up by a dedicated and very experienced professional Radio Communication Services Section with complementary capability in IT within Fire Management Services Branch and Information Services Section. These groups are working to integrate DEC's communication and information systems for fire applications and are currently undertaking a systems upgrade that will put full satellite, mobile phone, radio and web

access systems into mobile units suitable for deployment to OPs or ICCs. In view of the experience at Boorabbin, DEC will also provide VHF units in remote region offices that are likely to be used as ICCs so they can talk to aircraft when in range. The main radio communications technical challenge in remote regions is the lack of a VHF repeater network to cover the fire ground. It is not cost effective to put a permanent VHF (short range) radio repeater net work in remote regions where HF is the current standard just to create compatibility with visiting VHF equipped crews. The practical solution is to investigate more effective mobile VHF repeater systems that can be deployed easily and reliably in remote regions with flat terrain (few high transmission points) and very high ambient temperatures. The mobile system needs to have the capacity to cover the footprint of the average large remote region fire where direct suppression action is implemented.

The State of Western Australia is currently upgrading its West Australian Emergency Radio Network (WAERN) that promises a whole-of-Government and all-hazards approach to emergency communications enabling a broad range of service providers to communicate with each other in the field. This initiative is designied to overcome any previous difficulties of interoperability of radio systems amongst emergency services.

A special issue was raised in debriefs about the use of UHF (CB) radios so fire fighters can talk to truck drivers and other travelers using this system. It was observed that some DEC staff overheard truck drivers using UHF radio and have since reflected if it might have been useful to be able to more systematically listen to their traffic and talk to them if necessary. The question of whether some form of fire danger or roadblock warning might have been issued via UHF radio to travelers, particularly truck drivers, has also been asked. GFR vehicles do have UHF radios fitted but the few at the fire were not, as far as DEC knows, used intentionally by the IMT to communicate with private vehicles on the GEH. As described in debriefs, a DEC fire crew waiting at the gravel pit refuge site did listen incidentally to some of the UHF traffic on a DEC light vehicle radio that happened to be in earshot. The crew leader had one of his crew speak to the truck drivers the could hear on the UHF radio to ascertain their situation and found they were being attended to by FESA and police units further to the east.

DEC discovered in late 2008 that a bulldozer contractor, Breakaway Earthmoving, on his way to the fire to assist DEC, had used his UHF radio to transmit something of a warning to truck drivers about entering the fire zone on the GEH because a DEC Operations officer had advised him by phone (between 2050 hrs and 2100 hrs) to not come through the fire zone and to return to Coolgardie. The Breakaway Earthmoving truck driver had stopped at the old Boorabbin townsite parking area on the east side of the fire when he sent the message to fellow truck drivers.

DEC does not know if other agencies used UHF radios to communicate with private vehicles on the GEH, particularly at this critical time in the incident.

The use of UHF radios routinely in fire situations is not part of DEC's standard procedures and virtually not used in DEC's south west regions. Considering this

background, it is not surprising that the IMT did not employ the few UHF radios available to communicate with CB units in private vehicles on the GEH at the Boorabbin incident and the Coordination Group would not expect them to have done so.

This PIA does not really have enough information to draw a conclusion about the effect a timely and purposeful use of the UHF radio might have had to warn drivers approaching the fire danger zone at Boorabbin. For example it is not known to DEC which trucks or private vehicles in the vicinity of the fire escalation had UHF receivers or how they might have reacted individually or collectively to warnings. As the fire was bearing down very rapidly on the GEH at an angle and on a wide front it would have been difficult for drivers to know where they were in relation to the oncoming fire and in relation to the description of the danger area in a warning. To be effective, any such warning would have had to be reliably informed of the extent and location of the impending fire impact zone on the GEH, and as the fire escalation was a surprise to the IMT and other agencies at the fire, there was insufficient knowledge or time to produce an effective warning. A revealing indicator of this situation is the fact that the IMT thought they had placed the FESA officer (sentry) at a suitable position on the eastern edge of the existing fire zone but the location proved to be in the midst of the fire when it rejuvenated and bore down on the GEH from the south west.

DEC needs to investigate the efficacy of CB radios in circumstances like the Boorabbin incident and if useful implement procedures for using them. The WAERN upgrade of the radio system will provide the UHF (CB) band, so the issue in the future is more about the procedures for using the radios to communicate with private CB units than the availability of the hardware. The short range of the CB system will need to be taken into account in any deployment on a fire ground or on an extensive system of roadblocks. The development of any arrangements or procedures will need to be coordinated across fire HMAs and supporting agencies and services to ensure they will be applied conventionally and effectively. Consultations with representative transport industry bodies will be necessary. It is likely that new VCP Guidelines will not be dependent on UHF communication with road traffic, but it might be a useful adjunct communication facility and should be examined for that potential.

DEC routinely uses commercial and public radio channels (AM and FM) to broadcast fire warnings and information about road closures or other impacts associated with wildfire management. By the time of the fire escalation on the evening of Sunday 30 DEC had issued six formal written media updates on the fire and the road blocks. Such broadcasts are useful to warn travellers that still have the option of avoiding the fire ground and can also be helpful as updates to people waiting at remote roadblocks, but would not be effective in extremely short timeframes such as the time it took for the Boorabbin fire to escalate on the evening of Sunday 30. As previously described, warnings by definition are predicated on prior knowledge and determinations, which did not exist in relation to the fire escalation caused by the south west wind change.

Communications systems are integrating with digital IT systems and becoming more complex to comprehend and use. The AIIMS function of the Communications Support

Unit and the production of a Communications Plan is therefore becoming ever more critical and complex, particularly in remote regions presenting communication challenges. Training for these specialist roles and specialist ICS products needs to keep pace with the rapid development of communication and IT systems. More general user training for IMT staff and combat staff is also necessary.

Effective communications are essential for safety and coordinating multi agency incidents, especially with sectors or divisions involving road traffic management. At Boorabbin this was done effectively by the appointment of liaison officers using mobile phones. Western Australian emergency services agencies already have reasonably well integrated communication systems and these are currently being further upgraded through the implementation of the WAERN system.

Recommended Actions

1. DEC will continue to upgrade of its field-based mobile and fixed communications and IT facilities that will resolve the technical issues experienced at the Boorabbin fire.

2. The mobile VHF repeater system will be improved to cater for the expected conditions of remote region fire grounds.

3. IMT staff, particularly Planning Section, will receive additional training in communications and IT procedures and facility management. All senior staff involved in fire operations and emergency incident management will be trained in the capabilities and limitations of DEC's incident communication systems.

4. Staff will be routinely trained in the use of satellite phones.

5. Staff filling roles in the Communications Planning Unit who prepare and monitor the Communications Plan will receive specialist technical training and guidance on the preparation of Communication Plans.

6. There will be an emphasis on the production of a communications plan at incidents where communication challenges or complexities might be experienced.

7. Specialist communication and IT staff will be sent to fires at an early stage when necessary.

8. Mobile communications units will be deployed to fires at an early stage when communications challenges or complexities might be experienced. DEC will review if there are sufficient mobile repeaters available for remote region fires.

9. DEC will ensure that interagency communications are provided for through participation in the WAERN program.

10. DEC will continue to ensure there is effective communications for aircraft SAR in remote regions that comply with CASA regulations and the facilities and procedures provided by Air Services Australia.

11. The transmission of digital data and complex documents by satellite and the web will be enabled through the Department's review and upgrade of its communications and IT fixed and mobile systems for fires in remote regions.

12. DEC will investigate the use of CB radios (WAERN) and if useful they will be included in the mobile communications units to enable radio traffic monitoring and transmission with travelers using this system. Radio communication protocols and procedures will be developed accordingly.

3.9 Fire Weather

3.9.1 Weather Forecasts

Debrief Issues

The IMT received and used a number of forecasts during the first three shifts, listed here:

- District Forecast and synoptic situation discussed at the SOO conference call at 1615hrs on Friday 28 December 2007
- Spot Forecast issued 4:22 pm Friday 28
- District Forecast issued 4:33 pm Friday 28
- Spot Forecast issued 5:10 pm Friday 28
- District Forecast issued 4:28 am Saturday 29
- Spot forecast issued 10:07 am Saturday 29
- District Forecast and synoptic situation discussed at the SOO conference call at 1615 hrs on Saturday 29
- District Forecast issued 4:25 pm Saturday 29
- District Forecast issued 4:02 am Sunday 30
- Spot Forecast issued 9:13 am Sunday 30

- District Forecast and synoptic situation discussed at the SOO conference call at 0915 hrs on Sunday 30

- District Forecast issued 4:07 pm Sunday 30

- Spot Forecast issued 5:09 pm Sunday 30

The State Operations Officer (SOO) discussed the District Forecasts and general synoptic situation and the progress of the low pressure trough over the first three days of the fire on the morning and afternoon phone conference calls for Duty Officers throughout the State. The potential for 'blow-up' conditions was discussed. Goldfields Region staff attended three of these conference calls. The SOO also obtained spot forecasts from BOM for the Boorabbin IMT and ensured they were transmitted to the ICC. The SOO noted the Significant Wind Change information on the spot forecast before faxing it to the ICC at 1711hrs on Sunday 30. The SOO did not discuss the spot forecast with the IMT. At 1730hrs he was dispatched to Perth to join the PFT that was deployed to the fire on Monday 31.

The PO indicated in debriefs that the forecasts were used on Saturday 29 and Sunday 30 to determine fire direction, fire suppression strategies, fire fighter safety, resource requirements and were a central element of the IAPs. Forecasts were discussed at some IMT meetings. It is evident that the forecasts were an active component of the planning process.

The IC used the forecast to predict the direction of the fire when it was first reported on Friday 28 and continued to use the forecast to maintain awareness of the direction and general behaviour of the fire over the first three shifts. The IC was able to corroborate what the forecast implied about fire behaviour with his aerial observations of the fire on Sunday.

In debriefs the Situation Officer gave an account of the frequent use of forecasts from the first briefing by the IC through the various planning processes on Saturday and Sunday and for the production of the IAP. The forecasts on Saturday were the key to understanding and planning for the extreme fire conditions predicted for Sunday. At 1026 hrs the SO sent what was thought to be a copy of the spot forecast by email to the OO at the OP but it was actually the district forecast.

At 1530 hrs an IMT meeting discussed the 'blow-up' conditions experienced at the fire that were making suppression activities very difficult. At 1530 hrs an IMT meeting discussed the possibility of opening the GEH about 1900 hrs, but noted that the decision would be subject to fire behaviour at the time.

At 1655 hrs the SO requested a spot forecast from the BOM and on receipt gave a copy to the IC and PO. The Planning Unit understood that the spot forecast was faxed to the OP but were unaware that there was no fax at Koora. Email records show that a spot forecast

was sent to the OO at 2156 hrs and the officer assisting the OO at 2234 hrs at the OP. The OO saw this email the next day when reviewing emails on his laptop computer.

The OO had email access to the district forecast and participated by phone in IMT meetings that discussed the forecast. Meteorological measurements were being recorded on instruments at the OP, namely temperature, relative humidity, wind speed and direction and atmospheric pressure. The readings were imparted to the ICC at some IMT meetings. The OO did not receive the spot forecast until 2156 hrs but was informed by the district forecast issued at 4:02 am WDT on Sunday 30 that there would be a *'fresh southerly change extending over the southern half in the evening with temperatures around 43^{o}C'*. The 4:07 pm forecast the same day confirmed that there would be *'hot northerly winds ahead of a cooler S/SE change extending from the south overnight'*. The spot forecast by comparison gave more detailed information within three hourly time segments and more specific timing on the south west wind change. Important details about dew point, temperature and relative humidity have indirect implications for fire behaviour by affecting fuel moisture content and therefore flammability. The specifics of wind strength is also very significant for scrub and heath fires that are essentially wind driven.

The IC and PO noted in debriefs that fires in the GFR generally become quiescent overnight except in *'extreme'* circumstances. The predicted south west change of wind direction and strength with its attendant projected RH and Dew Point was not identified as *'extreme'* conditions that would cause 'blow-up' fire behaviour. Although not cognisant of the spot forecast timing of the south west wind change, the OO was also operating on the assumption of the 'traditional' night time fire behaviour model and did not feel particularly constrained by a narrow window of opportunity to move traffic through the fire ground. The IC and OO were mindful of the possibility that the south west wind change might have some effect on the fire, but did not envisage an extreme escalation and thought they had provided a safety net by stationing sentries at each side of the existing fire on the GEH who could reinstate roadblocks should the fire flare up. In effect this was a similar approach to that successfully applied during the day's extreme conditions, albeit without the benefit of a far seeing helicopter based Air Observer, but, with the compensating advantage of presumed diminishing fire behaviour.

The BOM forecasts proved to be accurate during the first four shifts of the fire, including the prediction of a lull in wind strength prior to the onset of the south west change. The lull was described in the spot forecast as *'wind strength could drop to 10 – 20kph in the hour preceding the wind change'*. This subtle cue was misinterpreted as reducing night time fire behaviour perhaps because the IMT had not picked it up in the spot forecast and because the moderating fire behaviour met 'standard' expectations.

The description of the wind change being *'a cooler S/SE change'* and being *'southerly'* may have created an expectation of milder conditions emanating from the coastal areas, but as was pointed out in debriefs, it is likely that the large mass of very hot air that moved south with the day's northerly winds, was in fact pushed back by the south westerly wind over the fire ground thereby sustaining the heat and dryness of the air mass

rather than cooling it. This phenomenon would help to explain the very rapid escalation of the intensity and rate of spread of the fire along its entire south eastern flank as multiple ignition points were stimulated by sustained high air temperature and strengthening wind.

The recognition of the subtleties of local weather patterns (e.g. the variations in the southerly change) on fire behaviour in the GFR would not be a widespread skill in DEC staff considering the fairly recent extension of an active fire management and fire suppression program to that region.

Coordination Group Review and Discussion

The Coordination Group considers that the Boorabbin IMT was well served by the Bureau of Meteorology. Forecasts were timely and accurate. The BOM has produced a report on the forecasts relating to the fire titled 'Meteorological Aspects of the Boorabbin Fire 28 December 2007 – 8 January 2008 BOM 23 May 2008'. This report gives a comprehensive account of the weather conditions, both predicted and actual, during the fire and how they were derived. The report also places the conditions on Sunday 30 into their historical context and ranks their comparative severity.

IMT leaders were aware of the weather patterns on the first three shifts from the general area forecasts they had received. Knowledge of the expected weather was a principal consideration in all planning for combating the fire. Along with the fuel types, it determined the fire suppression strategies and safety precautions for fire fighters.

Changes in wind direction had the greatest influence on fire management strategies as it determined where the head fire would go and what suppression achievements were needed to stop fire runs in new directions. Wind direction was also recognized as the most diagnostic parameter for a renewed threat to the GEH. On Sunday 30 wind strength and direction changes were accompanied by more severe fire weather conditions in terms of temperature and relative humidity that increased the difficulty of containment on sector C and generated the threat to the GEH.

The debriefs demonstrated that forecasts were well used to determine the main stratagems for managing the fire but also confirmed that there were two significant problems with the way the forecasts were handled and interpreted within the IMT.

The first issue is that the small section of the spot forecast that gave additional information about the south west wind change on Sunday evening was not read by the IC, PO, SO or OO. At least, they cannot recall reading it, which may mean it simply did not register as significant or that it was not really noticed because the main part of the forecast seemed to give the requisite information and confirm existing knowledge from previous forecasts. In the case of the OO it was because the spot forecast was not successfully transmitted to the OP. The Planning Unit thought it was sent by fax to Koorarawalyee, but in fact there was no fax operating at the OP and they had inadvertently sent the District forecast. The OO received a forecast on his laptop

computer, but it was the district forecast not the spot forecast detailing the wind change. The OO did make an attempt to acquire the spot forecast himself via the BOM registered users website on his laptop computer but could only find the general forecast and as he expected a copy from the IMT did not persist. In debriefs the OO and the Coordination Group reflected on whether the more detailed information in the spot forecast might have alerted the OO to the risk of fire escalation with the south west wind change. Whilst the spot forecast is more informative, it was already known to the OO from the district forecast that the southerly wind direction would vector any rekindled fire back towards the highway, so the missing link that would trigger an expectation of a resurgent fire was cryptically locked into the parameters affecting fuel moisture. It is not immediately apparent to the Coordination Group that these parameters would spark the recognition of 'blow up' conditions without the assistance of a GFR shrublands fire table, or as a substitute, a great deal of experience with such conditions. Neither of these options applied to the OO any more that they did to the other members of the IMT and so it is not possible to say in hindsight what affect the spot forecast might have had on the OO with respect to the agreed IMT strategy to open the highway.

Spot forecasts are more specific to the fire area and are produced by BOM at the request of the IMT. Forecasters preparing spot forecasts take into account any detailed local information or meteorological effects that they know about and so the spot forecast can be a more informative tool for IMTs that the general area forecast and is usually regarded as such.

The IC, PO, SO readily volunteered in debriefs the fact that they could not recall reading the text box titled 'Significant Wind Change' situated below the main forecast text box titled 'Forecast Conditions' (see Appendix 3). The Forecast Conditions gives the weather forecast in three hour time segments covering temperature, dew point, relative humidity, wind direction and strength including gusts. This is the familiar format that DOs involved in fire duties utilize on a daily basis during the fire season. The Forecast Conditions carries most of the information about the weather conditions and so a reader might think they had a grasp of the essential information solely from this main part of the forecast. This appears to be what happened with the members of the IMT that looked at the forecast. This is quite literally an 'oversight' problem.

The Forecast Conditions text box does reveal that the south west wind change will occur in the 2100 hrs to 0000 hrs forecast period whereas the Significant Wind Change text box says the *'S/SW change expected at site approx. 1900 – 2000. Gusts to 50kmh possible.'* The difference in the two presentations is that the Significant Wind Change version targets the actual wind change time frame whereas the Forecast Conditions version presents an artificially divided set of three hour time slots. The Forecast Conditions text box might therefore seem less specific and more open to speculation about when in that time slot the change might occur. The Significant Wind Change information is an important supplement to the three hour predictions as it can mean the wind change could occur two hours prior to the initiation of the 2100 hrs three hour time slot, at 1900 hrs. In the actual event the south west wind change moved through the area between 1930 and 2000 hrs.

Attached to the Significant Wind Change text box is another titled 'Weather/Remarks'. It predicts the drop in wind speed just prior to the south west wind change but warns that there may be some uncertainty in the exact timing of the wind change due to lack of monitoring equipment near Southern Cross. It is likely that the mild fire behaviour reported by the Air Observer in the helicopter and those on the ground was partly the predicted lull and partly the onset of reduced evening conditions. The IMT interpreted it as the latter.

So the IMT was expecting the south west wind change to occur around about or after 2100 hrs.

The Coordination Group believes the oversight of the supplementary wind information in the spot forecast by the IMT is a serious procedural problem and also caused an error in the IMT's expectation of the time of arrival of the wind change. It did not by itself cause the fateful underestimation of the effect of the wind change on fire behaviour, as will be explained in the following.

It is a tenet of fire fighting that the weather forecast is one of the most important pieces of intelligence available to the IMT. The weather is the single most important determinant of fire outcomes and so fire fighters are trained to pay great heed to forecasts. It is a lapse of this training and awareness to not read and absorb all of the forecast. The only explanation for this occurring in several instances at the Boorabbin fire that the Coordination Group can suggest is that the officers felt they had noted the key information in the forecast and thought they were fully aware of the important aspects of the oncoming weather. The sharp lesson to learn from this oversight is that the entire forecast must not only be read, but must be scrutinised, particularly looking for any uncertainties or warnings that might need to be accommodated into a risk managed response or worst case scenario. Fire managers know that two parameters in forecasts can be variable; the intensity of parameters and the timing of them. Fire managers must simultaneously rely on the forecast, but also allow for its uncertainties. DEC fire managers, particularly IMT Planning Unit staff, are trained in fire weather meteorology and many DEC fire management staff have years of experience in dealing with forecasts and interpreting and working with them in prescribed burning and wildfires. Perhaps this familiarity can also be a trap when experienced officers such as some of the IMT leaders at Boorabbin look for the main message in the forecast and pass over some of the supplementary detail. Evidently, DEC needs to re-emphasise the critical importance of reading and absorbing <u>all</u> of the forecast - every time. This will be done in preseason briefings and in formal training. There also needs to be protocols and checks controlling the sharing and confirmation of receipt of forecasts within and outside of the IMT and by Duty Officers. The detailed discussion of forecasts and forecast updates needs to be a prescribed standing agenda item at IMT meetings.

With respect to this issue at Boorabbin, the critical question is what effect on the outcome of the fire did the oversight of the spot forecast have on Sunday evening? The IC and OO were working to the general forecast timing of the wind change that was two hours later than the Significant Wind Change prediction and they were mindful that in organizing the

after dark convoys for a target time of 2000 hrs they expected to be preceding the wind change. They were aware that there was in effect a time gap between the subdued late afternoon fire behaviour and any change that might eventuate from the south west wind change. However, as they expected the current quiescent fire behaviour to be relatively unaffected by the south west wind change they did not really feel they were working within a critical window of opportunity for the passage of the convoys. Furthermore, they had provisions in place in the form of sentries and police convoy escorts as a safeguard against any *'unlikely'* change in fire behaviour when the wind shift came.

In debriefs there were a number of suggestions that daylight saving time (DST or BOM's Western Daylight Savings Time (WDT) (UTC +9 hours)) might have had a significant but unrecognised influence on the assessment of fire behaviour by the IMT as it sets an earlier anticipation (by the clock) of the onset of night time fire conditions. This creates the potential to underestimate evening fire behaviour. The Coordination Group are not persuaded WDT had much if any effect, as direct fire observations were guiding the IMT combined with their general expectation of quiet overnight fire behaviour. The fire behaviour significance of the southerly wind change that evening was not really affected by WDT as it was a synoptic change (frontal), not just a local diurnal pattern. The forecasts were issued as WDT.

The unexpectedness of the rapid fire escalation had little to do with misreading the timing of the wind change but everything to do with misinterpreting the weather parameters that were read (temperature, dew point, relative humidity, wind strength) with the result that the IMT did not foresee the 'blow-up' conditions that would almost immediately create extreme fire behaviour despite it being night time. Had the IMT translated the Forecast Conditions of the spot forecast into extreme fire behaviour comprising rates of spread already seen at Boorabbin of several kilometres per hour, it would not have been an acceptable strategy to utilize a narrow window of opportunity to allow the passage of convoys dependent entirely on the absolute accuracy of a forecast. It is true the IMT was using 'windows of opportunity' for the passage of convoys during the day, but the main tongue of the fire had largely passed south of the GEH and was being totally monitored by the helicopter. The 'windows of opportunity' were presented by extended observable periods of quiet fire behaviour along the GEH with only occasional limited flare ups adjoining the Highway. It was a carefully managed risk with full information, vigilance and care – and was successful. The IMT thought they were converting this successful model to a night time condition that had more favourable weather and fire behaviour than that experienced during the day and it was not really seen as depending on a special window of opportunity afforded by the weather. The crucial difference compared with the daytime model was that any change in fire behaviour would be vectored back towards the GEH by the south west wind change rather than away from it, and unbeknown to the IMT, the sentry/sentinels would not provide the far seeing early warning assurance that the helicopter based Air Observer was able to do.

A further question arises as to whether DEC expects an IMT in the circumstances at Boorabbin to be aware of the possibility that the fire might escalate with the south west wind change and to 'compute' and predict its behaviour in a quantified fashion based on

the actual weather parameters and known fuel types? This question has been canvassed and discussed in other parts of the PIA, particularly Strategic Analysis of the Fire and Fire Prediction.

The Department of Environment and Conservation's formal answer to this question is presented in the Witness Statement for the Coroner by the Manager of Fire Management Services. In brief, it states that the Boorabbin IMT did not have the requisite technical tools to hand in the form of a shrubland fire prediction guide or a fully comprehensive guideline for managing roadblocks. The prior practical experience of the members of the IMT in relation to the severe night time weather conditions and extreme drought affected dryness of the fuels in that environment was insufficient to compensate for the lack of adequate standard operating guidelines and procedures and fire prediction tools. This scenario results from the evolving history and nature of fire management and suppression in the GFR in these fuels that contrasts with the longstanding fire management operations in the south west forests. Staff and fire crews from the south west areas, including those with GFR experience, deferred to the customary expectation that shrubland fires would become relatively quiet overnight and therefore did not try to extrapolate their technical knowledge or experience of coastal mallee heath fires to the situation at Boorabbin. This official DEC explanation of the IMT's assessment of the weather and consequent fire prediction developed from a careful consideration of all aspects of the debriefs, the GHD reports and the PIA process as well as thorough review of DEC's standard operating guidelines and procedures.

This central issue of the Boorabbin incident has also been intensively debated within the Coordination Group, discussed with IC leaders of PFTs and fire specialist officers and senior staff. The consensus is that most very experienced DEC fire staff are reluctant to say with certitude that they believe they would personally have picked and predicted the fire escalation on Sunday evening. Part of this reticence is of course caution about wisdom in hindsight. None offered any scientific or SOP reason for why they would have predicted the fire escalation. None of the fire operational staff said they would expect to use the South Coast mallee heath fire prediction tables. However some very experienced fire managers said they thought the spot forecast conditions on Sunday evening still looked fairly severe, although evidently declining, and expressed the hope that such a forecast would prompt them to a cautious response in similar circumstances. Some noted the south west wind direction towards the GEH as something to take into account. Some very experienced senior fire staff commented that the Boorabbin night time fire behaviour reminded them of other very large fires they had experienced that exhibited extreme night time fire behaviour, but none could say that the circumstances were identical to the Boorabbin fire, and none were examples of DEC fighting a large fire overnight in the GFR environment. The other observation from those that have seen the Boorabbin vegetation is the evident drought stress that they remark presented an exceptional background of very flammable low fuel moisture content.

Reflecting on these deliberations, the Coordination Group feels that there is some possibility that despite their diffidence when asked retrospectively, some of the most experienced Level 3 IC's and L3 POs might have taken a more precautionary approach to

the south west wind change based on a combination of instinctive risk assessment, simple analysis of the wind strength and direction and the fuel types, but they would be unlikely to employ the out-of-context mallee heath fuel table derived for the south coast area and therefore their strategy would be intuitive rather than quantitatively based or computed. Whilst acknowledging the possible hypothetical range of precautionary responses by individual ICs and IMT leaders, the Coordination Group's overall conclusion is that the Boorabbin weather and fuel conditions on Sunday evening were an extreme set of circumstances, as noted in the BOM report and review of the weather conditions on Sunday 30 in the Boorabbin area, and would have been outside of the direct experience of the staff involved and indeed outside of the experience of most staff in other PFTs. With no accepted technical formula to hand for determining fire rates of spread overnight in those fuels it is expected that most staff in IMTs would have defaulted to the common (local) wisdom in accepting that the fire would continue to be fairly quiet overnight as it had been during the previous two nights. This assumption would have been reinforced by direct observation of declining fire behaviour at dusk along the entire fire flank.

The last question in this line of enquiry is how is DEC going to formulate the Boorabbin experience so that future IMTs do not overlook any aspect of the weather forecast and also translate weather forecasts parameters into sound fire behaviour predictions in these settings? The answer lies in the following recommendations that will be captured in DEC's Findings and Actions report.

Recommended Actions

1. Training of IMTs will continue to emphasise the critical importance of the weather forecast in all situations.

2. Training of IMTs will include skills development in reading, interpreting and applying forecasts.

3. The presentation of critical warnings or special information in forecasts will be reviewed to see if they can be more prominent to the reader. Any recommendations will be presented to BOM for their consideration.

4. Protocols will be established for obtaining, handling, sharing, transmitting and receiving forecasts within IMTs and Duty Officer networks.

5. The SDO will discuss the forecast with IMTs at least once each shift, in addition to the routine dissemination and discussion of forecasts through the standard daily telephone conferences with duty officers. All regions DOs, the SDO, and a representative of any current IMTs will participate in all scheduled daily teleconferences.

6. IMT officers will be required to discuss the forecast with either the RDO, SDO or SOO at least once each shift. IMT officers will be encouraged to discuss the forecast with the BOM duty officer via the established protocol.

7. ICs will ensure that appropriate general and spot forecasts are obtained and disseminated throughout the IMT and they are read and understood.

8. POs will ensure that the presentation, discussion and interpretation of the forecast and forecast updates is a standard agenda item on IMT and Planning Unit meetings.

9. POs and SOs will assess the range of fire behaviour possible within the forecast parameters (and other fire variables), including a 'worst case scenario' for strategic planning purposes and risk management.

10. SDOs, ICs and POs will ensure that they have a sufficiently skilled and experienced fire behaviour analyst in their IMT at L3 fires who is dedicated to the production of timely fire behaviour predictions based on interpreting forecasts and is not unduly distracted by other planning tasks.

11. The interpolation and application of mallee heath tables to the GFR and Wheatbelt Region will be documented with particular reference to the forecast weather conditions that are preconditions to the use of the table. Training in the use of the tables with reference to relevant interpretation of the weather forecast will be undertaken.

NOTE: The Coordination Group acknowledges that these recommendations are already part of traditional practice and also happened to varying degrees within the Boorabbin IMT. However, the Boorabbin experience indicates the need for increased emphasis and discipline in the application of these principles and practices including the adoption of any improvements made to written SOPs.

3.10 The Incident Management System

3.10.1 Incident Action Plans

Debrief Issues

The IMT Planning Section commenced work on the second shift of the incident at approximately 0900 hrs on Saturday 29 December and comprised a team of four, being the Planning Officer, the Situation Officer, the Resources Officer and a Management Support Officer. They correctly regarded the production of an IAP to be their prime task, as did the IC. The PO and SO gathered information from the office to help them prepare an IAP. At 1130 hrs they conducted an IMT meeting to discuss current strategies,

resources and logistics and were asked to produce an IAP by 1900 hrs that day to apply to the next day's operations. The IAP would only apply to the daytime as there was to be no night shift as it was expected that the fire would be quiescent overnight with no fire suppression action undertaken. The PO's schedule was to have a draft IAP by 1700 hrs, a final version by 1900 hrs that would be signed by the IC and reproduced copies ready for dissemination by 2000 hrs.

By 1300 hrs the Planning Section had produced parts of the IAP, namely ICS form 2.1 (IAP Operations Summary) and 1.1 (Situational Analysis – Background and Objectives) and also a map showing the fire shape and current sectorisation of the fire. These sections of the IAP documented the objectives, strategies and tactics to be employed to contain the fire north of the GEH. The SO had concentrated on the Operations Map and other duties rather than situational analysis.

By 1830 hrs the IAP was completed and signed that evening by the IC and twenty one copies made in readiness for dissemination to IMT leaders, Division Commanders, Sector Commanders and Crew Leaders the next day. Early on Sunday the crews were briefed by the IC and PO about contents of the IAP and the document distributed.

On Sunday the Planning Team had to divide their time between a number of tasks. The PO stood in for the IC who went on a reconnaissance flight and the SO attended to various liaison tasks and to information responses with the DEC media officer as well as preparing a revised IAP for the shift the next day. During the afternoon on Sunday the PO held IMT and Planning Team meetings to discuss the various considerations relevant to the revision of the IAP. They decided that the fire fighting strategies adopted in the first IAP were still valid for the fire run to the south of the GEH. All members of the IMT had input into the revised IAP that covered current fire information such as its location, shape, active fire zones, weather forecast, vegetation maps, roads, resources available, assets and strategies. The strategy focused on indirect attack on the eastern side of the fire along the Duri Track and direct attack on the western side of the fire constructing fire lines. Areas of low fuel such as salt lakes, old fire scars, woodlands would be utilized as part of the containment.

At 1650 hrs the SO had a map of the fire sent (signed by the IC) to service stations along the GEH to inform the public about the fire. At 1730hrs the PO requested the SO finalise the IAP by 1830 hrs. The SO continued to be involved in liaison, information and fire response functions as the fire escalated in the evening and was not able to fully concentrate on the IAP or situational analysis. By 1900 hrs much of the IAP for the 31 December had been prepared.

In debriefs a number of the issues raised related to the IAP which is to be expected as the IAP is the strategic plan for the management of the fire. The most significant question asked was "had DEC become too *'process focused'* by the numerous ICS templates comprising the IAP document at the cost of considerable resources, time and possible loss of strategic foresight?" Some felt that there was a trend in this direction at major

incidents in recent years. A related question asked if DEC had become too sophisticated and dependent on computer derived products such as GIS based maps.

Another key observation was that the Planning Section was under resourced for the task and consequently burdened by multiple roles and functions. The workload would exacerbate the problem of trying to fully achieve all of the IAP processes and have a cumulative effect in reducing attention to basic and essential situational planning tasks such as fire behaviour and projection.

Coordination Group Review and Discussion

The Coordination Group wishes to acknowledge that aspects of the IAP were praised in debriefs, particularly its role in enabling comprehensive briefings to crews, its critical focus on the safety of fire fighters and the correct specification of fire suppression strategies and the early organization of sectors. The strenuous efforts of the small Planning Team (described briefly above), heavily burdened as they were by multiple tasking, brought about these desirable outcomes and gave effect to many of the intended functions of the IMS IAP.

The most significant deficiency in the IAP was the inadequate anticipation of fire behaviour and projection of the fire's path over a number of shifts for as far out as the forecast allowed. This deficiency mostly resulted from the "one shift" focus of the IAP on Saturday that did not anticipate the overnight fire behaviour on Sunday evening. The Sunday IAP revision process that proceeded in an interrupted fashion during the day did not pick up the first IAP's oversight of a fire escalation on Sunday evening with the predicted south west wind change. It is difficult to say to what extent the issues identified in the debriefs, namely Planning Section being under resourced and therefore weakened by multiple tasking, contributed to the IAP not foreseeing the full potential of the Sunday night fire escalation. All the Coordination Group can say in retrospect is that it agrees with the debrief comments that the Planning Section was under resourced, probably from the outset, and this did undoubtedly give the Planning Team an excessive workload. Other issues such as the 'standard belief' that fires generally become quiescent overnight, the absence of an accepted shrubland fire behaviour guide, the misreading of the forecast, the success of the road escorted convoys and a misplaced faith in the overnight sentry system of partial road blocks, and the culminating deception of the weather lull before the wind change, all combined in a way that the systematic IAP process did not counteract.

As a general overview and reflection, the Coordination Group does not believe that AIIMS, or the IMS system adaptions that DEC has developed, particularly the (ICS) templates, are intrinsically flawed. Completing the ICS documents might seem somewhat daunting and might sometimes be portrayed as excessive paperwork, but considered objectively, the IAP only demands information and thought processes that are needed to deal with wildfire incidents, especially large ones. The question should not be the size or complexity of the system but rather how it is interpreted, resourced and used. And the answer to that question is that the system is scaleable and its elements can be employed to match the requirements of each unique fire and the changing phases of a fire. Some

elements of DEC's IMS system are so basic and critical to fire management as to be essential every time, whilst others might come into play or be fully employed as circumstances dictate. The incident classification system is a crude indicator of the escalating need for IMS and IAP complexity.

One particular example the Coordination Group highlighted is the large burden of work associated with the current ICS template approach to recording and documenting every detail of resoures at the fire, particularly individual people and vehicles. The Coordination Group felt that economies could be made in this area without losing critical strategic, logistical, welfare or safety information.

Despite the general soundness of the DEC IMS system, a review of the emphasis it places on strategic analysis of a fire projected over several shifts and the types of written or graphical product required from it in various fire circumstances and reporting timeframes needs to be reexamined.

The extensive and intensive training DEC IMT staff receive in the use of DEC's IMS will need to explain any changes to the system resulting from lessons learnt at Boorabbin and also place emphasis on adapting the various sections of the system to the demands of each individual fire.

Any modifications to the system will need to preserve the important function of accurate and complete record keeping. This not only serves post fire incident analysis and accountability, but is also critical for the continuity of plans and information between shifts and between PFTs in protracted fires. The IAP is also an essential part of the communications system in a fire in written and graphical form and is an 'old tech' but reliable way of sharing information, objectives, strategies and safety messages within the fire team.

Recommended Actions

1. DEC will review the ICS templates, particularly Situation Analysis and make any improvements necessary to ensure that it elicits a strategic appreciation of the potential of the fire over an extended timeframe so the full scope of the incident and the response needed can be ascertained as early as possible.

2. DEC staff training on IMS/IAP will emphasise the intent and purpose of each section of the IAP and stress a focus on the insights and outcomes rather than the process or product. Adaptive use of the system to achieve strategic, pragmatic and timely outcomes is the main message. This approach needs to be balanced against the elements of the system that experience has shown are essential for effective and responsible record keeping and formal justification of decisions made.

3. Technical training of Planning Section (particularly Situation Unit) staff will need to include the application, adaption and limitations of using mallee heath fuel tables for fire behaviour computations in shrubland environments.

4. Training of all IMT leaders and Planning Unit staff, will make close and disciplined attention to the reading and interpretation of the weather forecasts (general and spot forecasts) absolutely mandatory. A system of automatic sharing and discussion of the weather forecast in IMT meetings will be instituted. Confirmation of receipt of forecasts will be a communication protocol.

5. The SDO and RDO will pay particular attention to the resourcing of the Planning Section and Situation Unit if there is a risk of insufficient strategic intelligence output from the IMT. The anticipation of resource requirements for any fire will continue to be a blend of the fire classification, prevailing hazard, other fire commitments and overall risk assessment and judgment by the SDO and IC, shared as appropriate with other senior staff.

6. The SDO and RDO will maintain adequate situational awareness of remote region fires by the receipt of appropriate and timely IAP Situation Analysis reports from the IC.

7. ICs will be reminded to expect a strategic assessment and longer term projection of the fire as an early task for the Planning Section. ICs will be required to share this with the SDO.

8. A general guideline will be given to ICs, SDOs, RDOs and POs; that Situation Officers should be adequately resourced to ensure continuous incident analysis and prediction. If a fire requires the services of a Situation Officer then the production of a Situation Analysis should be their prime task. The situation analysis is a primary component of the IAP.

3.10.2 Fire Maps

Debrief Issues

Maps were an essential and valuable tool at the fire, both pre-existing maps and created maps. The IC was able to consult existing maps in the ICC from the outset of the fire. The OO took his own maps to the OP as a precaution, including a topographic Auslig series map with some assets depicted, a Landsat image, vegetation map (Beards) showing five main fuel types and a fire history map. GFR staff setting up the OP also had field maps. Maps of the local area were required for incoming crews who could not be expected to have their own maps of another region. The Air Observer in the helicopter also needed local maps.

A number of maps were produced by the IMT at various times during the long duration of the fire. Perhaps the main map used to display key information was the one drawn on the white board at the OP that also served to inform those arriving at the OP about the basic configuration of the fire ground, IMS roles, logistics and communication

information. This map was photographed and printed and given to fire crews departing the OP.

The Operations Section at the OP produced plots of the fire location and shape on 29 December using a PDA/GPS in the helicopter. A trial version of 'Oziexplorer' software was downloaded from the internet onto the OO's laptop to enable the transfer of the fire shape to the IMT in Kalgoorlie by email. This fire shape was modified during the afternoon/evening of the 29 December as the running fire was extending in a west-north-westerly direction. The fire shape south of the GEH was again mapped with the PDA/GPS on the evening (approximately 1830 hrs) of the 30 December. During the 29 and 30 December these GPS plots were used to determine rate of spread, distance of fireline to be constructed and to plot assets relative to active fire.

On Saturday 29 at 2030 hrs a professional GIS Situation Mapping staff member joined the IMT. Until that time the Situation Officer experienced some difficulties attempting to produce high quality GIS products. A GIS position is part of the standard full PFT, working within the Planning Section.

DEC has progressively over a number of years improved the quality of map products at wildfires using high quality GIS on-line data and applications. These high quality professional products have become the accepted and expected norm within and emanating from IMTs.

The following maps were produced during the first three shifts:

Note: The Boorabbin incident maps may record a number of different times that can refer variously to the title of the map, the timing of things depicted within the map (e.g fire area), the time the map was approved by the Planning Officer or other officer, the time the map was produced by the Situation Officer or GIS Mapping Unit Officer, the time the map was used for some purpose (e.g. hand written annotations on the map). The time noted by the situation or mapping unit officer can refer to the time a particular mapping project was commenced and may not have much relevance to the time the map became operationally active.

Note: The scale of maps is recorded as a representative fraction when printed at a particular map size (e.g. A3 print). The Boorabbin incident maps are not always printed at A3 and may be enlarged or reduced by the map maker or by photocopying and later reproduction and are therefore not rendered at the scale on the map index.

Shift 1 Friday 28 December 2007

- The RDO at Kalgoorlie plotted the fire on the regional office wall map when it was reported at 1510 hrs Friday 28 December. The plot of the fire was confirmed by the DEC reconnaissance officers from the fire ground shortly after 1800 hrs on Friday 28. It was not preserved as a hard copy map.

Shift 2 Saturday 29

- Approximately 1100 hrs. Hand drawn map on whiteboard at Koora. Showing: estimated fire location and extent over Merbine Track, OP, GEH, distances, some assets, IMT leaders, contacts.

- Time unknown. 1:250,000 at A3, base map Boorabbin and GEH area, crude depiction of fire location and assumed shape, attempt at sectorisation. Covers Yellowdine to Boondi.

- 1250 hrs (map title) 1250 hrs (map index). 1:250,000 at A3, base map of Boorabbin area and GEH. Showing: fire location, shape and size (3170 ha), fire scars and salt lakes. Covers Karalee to Woolangie.

- 1500 hrs (map title) 1500 hrs (map index) 1: 150,000 at A3, base map, showing fire Sectors A, B, C, rare flora sites, containment line constructed, salt lakes, fire scars. Covers Karalee to Boondi.

- 1500 hrs (map title) 1500 hrs (map index). 1:150,000 at A3, basemap of Boorabbin area and GEH. Showing: fire location, shape and area (4500 ha), Sectors A, B, C. Covers Koora to Boorabbin (old townsite).

- 1500 hrs (map title) 1500 hrs (map index). 1:150,000 at A3, orthophoto Boorabbin area and GEH. Showing: fire location, shape and area (4500 ha), Sectors A, B, C; fire scars and salt lakes. Covers Koora to Boorabbin.

- 1500 hrs (map title hand annotated). Approximately 1:100,000 of Boorabbin area and GEH. Showing: fire location and shape, Sectors A, B, C; fire scars and salt lakes. Covers Koora to Boorabbin.

Shift 3 Sunday 30

- Time unknown. Hand drawn map on whiteboard at Koora of Boorabbin area and GEH. Showing: sketch of fire location and shape, some assets, sectors, key staff roles, phone contacts, sector resource allocations, list of hazards, list of assets at risk, OP location, radio repeater location.

- Time unknown but after 1500 hrs. 1:30,000 Orthophoto of Boorabbin area. Showing enlargement of sector C. Fire size noted as 4500 ha at 1500 hrs.

- 1646 hrs (PO approval) 1649 hrs (GIS Officer). 1:150,000 at A3, base map Boorabbin area and GEH. Showing: fire location and shape both north and south of the GEH, Sectors A, B, C, fire scars and salt lakes, OP location. This map is subtitled by hand “Field Info 30/12 – over Duri Track”. It contains a hand drawn

extension (7 km) of the head fire that crosses the Duri Track. Covers Koora to Boorabbin.

- 1957 hrs (PO approval) 1958 hrs (GIS Officer). 1:150,000 at A3, base map showing OP, location, shape and size of the fire (area 11191 ha, perimeter 85,486m), Northern Division – Sectors A, B, C, Southern Division – X, Y, Z; Highway Division. The head fire has crossed the Duri Track and met the salt lakes. Fire scars an salt lakes depicted. Covers Koora to Boorabbin.

- 1957 hrs (PO approval) 1958 hrs (GIS Officer). 1:150,000 at A3, Orthophoto Boorabbin and GEH area. Showing: OP location, fire location and shape (area 11191 ha, perimeter 85,486m), Northern Division – Sectors A, B, C, Southern Division – Sectors X, Y, Z; Highway Division. The head fire has crossed the Duri Track and met the salt lakes. Fire scars and salt lakes depicted. Covers Koora to Boorabbin.

- Time unknown (probably around 1957 hrs). 1:150,000 base map of Boorabbin and GEH area. Information as for 1957 hrs orthophoto map.

- 2059 hrs (PO approval) 2100 hrs (SO produced). 1:150,000 base map of Boorabbin and GEH area. Showing: OP location, fire location, shape and size at 1900 hrs 5250 ha, Sectors A, B, C; fire scars and salt lakes. Note: maps produced at 2059 hrs were included in the IAP. Covers area Karalee to Boorabbin.

- 2059 hrs (PO approval) 2100 hrs (SO produced). 1:150,000 orthophoto of Boorabbin and GEH area. Showing: OP location, fire location, shape and size at 1900 hrs 5250 ha, Sectors A, B, C; fire scars and salt lakes. Covers Karalee to Boorabbin.

- 2059 hrs (PO approval) 1339 hrs (GIS Officer). 1:750,000 base map covering Southern Cross to Coolgardie. Showing road closures at Coolgardie and Southern Cross, fire location and shape.

- 2059 hrs (PO approval) 1152 hrs (GIS Officer). 1:500,000 base map covering GEH Southern Cross to Coolgardie. Showing: fire location and shape, containment lines, various assets such as public utilities and DEC conservation assets such as rare flora locations, apiary sites.

- 2059 hrs (PO approval) 2100 hrs (SO produced). 1:150,000 at A3, Orthophoto of Boorabbin and GEH area. Showing: Location of OP, Sectors A, B, C, fire scars and salt lakes. Covers Karalee to Boorabbin.

- 2059 hrs (PO approved) 0826 hrs (GIS Officer) 1:150,000 at A3, orthophoto map showing Northern Division Sectors A, B, C; point of origin of fire, fire intensities likely from fuel types ex WTA-FPP as different coloured background. There are

no actual fire projections based on the background information. Map is titled "Predicted Rate of Spread". Covers Koora to Boorabbin.

- 2109 hrs (PO approval) 0851 hrs (GIS Officer). 1: 150,000 base map of Boorabbin and GEH area. Showing: fire location and shape (area 17909 ha, perimeter 89,924m), Northern Division - Sectors A, B, C, Southern Division - Sectors X, Y, Z; Highway Division, fire scars and salt lakes. Covers Koora to Boorabbin.

- 2230 hrs (map title) 2059 hrs (PO approval) 0912 hrs (GIS Officer). 1: 150,000 at A3, orthophoto (colour enhanced fire intensities of fuel types ex WTA-FPP) of Boorabbin and GEH area. Showing: Fire location, shape and size (17907 ha, perimeter 89,924m) with the head fire against the salt lakes, Northern Division – Sectors A, B, C; Southern Division – Sectors X, Y, Z; Highway Division, fire scars and salt lakes visible. No actual fire projections depicted. Map titled "Predicted Rate of Spread". Covers Koora to Boorabbin.

A map of the fire is perhaps the most informative thing an IMT can produce, and when up-to-date and accurate it underpins strategy, operations and information outputs. A substantial investment in mapping resources is therefore usually worthwhile.

There were generally favourable comments about the maps made available to officers and crews at the fire and presented to people outside of the IMT.

Despite the general satisfaction, the debriefs raised the question of DECs apparent increasing dependency on sophisticated map products needing expert GIS personnel. It was felt that IMTs might feel that anything less than an impressive GIS product might not be acceptable, particularly to recipients outside of the IMT circle. Maps of this quality might take some time to produce and so the question of timeliness can arise. Time critical actions, such as reporting the fire to the SDO, might be better served by cruder, but more immediate maps, such as hand drawn information on pre existing base maps. Hand drawn maps were common practice prior to the advent of electronic GIS products. Debrief participants were amenable to this suggestion, recognizing that it is only a perception that the appearance of maps has become so important.

Fire predictions might also be expedited by relatively simple hand drawn fire projections on base maps derived from estimated or calculated rates of spread and direction of the fire, until such time as they can be captured and depicted in GIS form.

The other classically limiting factor in map production is the slow availability of reliable information on the fire. The IMT noted that this common problem was also experienced at the Boorabbin fire to some extent, although it did not seem to produce critical deficiencies as the IC and OO had a sound situational awareness from their flights over the fire and phone communications worked well. The IC had taken the GIS base map produced at 2059 hrs on Saturday 29 by the Planning Section for the IAP (shift 3 on Sunday 30) in the aircraft when he did his reconnaissance of the fire on Sunday 30. He

annotated this map with a biro depiction of the fire's progress south across the GEH and made a projection of its run into salt lakes that proved to be quite accurate.

The transmission of maps from the fire to the ICC was hampered by the physical distance and an initial limited capacity to electronically transfer map data from the OP and there was no capacity to do it directly from the helicopter. The Situation Officer was regularly seeking field information on the fire boundary to assist with the production of maps of the fire for the IAP, for information purposes and for operations staff. The IMT tried to overcome the distance problem in one direction at least by ensuring crews were briefed and had copies of the IAP containing maps of the fire before departing Kalgoorlie each morning.

Probably the most essential map product would have been a fire projection map that predicted and depicted the run of fire with the south west wind change on Sunday evening. As previously discussed, the reasons this was not produced are not related to the availability of information transmitted from the field.

Sometimes at major incidents the flow of information between OP and ICC is more constrained by the availability of staff dedicated to support and liaison roles, rather than the information transmission technology. Comments by the OO about his work load and the pace of transactions, especially on Sunday after the fire breakout, confirms that there were too few Management Support staff available to him at the OP, and not enough people able to report back to the IMT at the ICC. Likewise, the Situation Officer producing maps at the ICC also divided the available time between a number of other roles and tasks and in hindsight needed other staff to do those roles. The GFR Officer supporting the OO at the OP showed initiative in assisting the the Planning Section at the ICC by helping them find local information such as an electronic version of the WTA-FPP fire intensities map for the Boorabbin area. He did this from the OP on Saturday and by attending the ICC in person on Sunday morning, although this also meant he arrived later at the OP that morning.

Questions about map production served to complement issues raised about the criteria for sending PFT and the roles in the team and the special constraints of fires in remote regions or near key life-line assets, and the setting up of OPs. The debriefs recommended that the functionality of the OP in relation to the ICC, particularly where they are separated by large distances, be examined.

Whilst it is acknowledged that DEC has a sophisticated GIS capacity that it readily sets up at major incidents, there may be a need to examine the transfer of map data in remote regions where the usual means of file transfer might not be available in the field. As a minor point, the OO noted that his dedicated role-based email address did not work.

The map issue also highlights the absolutely critical nature of communications of all sorts at fires. It is also discussed under Section 3.8.5 in this PIA and notes the need for specialized expertise to set up and maintain sophisticated communication systems at fires in remote regions and that they be tested pre-season.

Coordination Group Review and Discussion

Maps are a critical intelligence tool at wildfire incidents to show where the fire is located at particular times, where it might go in the future and how it is being managed with respect to sectorisation, the location of the OP, access, hazardous and safe zones and risk features, and for reporting the fire outside of the IMT to the SDO, other agencies, media and public.

There was a strong focus on producing and using maps at the fire. Maps formed a significant component of the IAP and assisted the IC, PO, and OO in giving effective briefings to incoming crews and staff. Maps of the fire were produced for public information purposes.

The SO had some difficulties producing the first maps due to limited information and the initial absence of a GIS Situation Mapping specialist. The SO also had to spend valuable time performing a number of roles, including some that were urgent. Despite these impediments, with commendable persistence, maps were produced and were very helpful for briefings. There was general praise of the maps available in the IAP. The main query about maps came after the fire when the question was raised of overdoing quality and GIS sophistication perhaps at the expense of a cruder but more timely depictions of the fire. The Coordination Group accepts these observations in a qualified way as the great improvements in map production and GIS value adding is highly regarded and needs to continue. Digital mapping is demanding of specialized operator expertise, but delivers significant advantages in its access to extensive map data bases and the ability to produce thematic maps tailor made from integrated background information and allows the depiction of special features. Top order GIS capacity can be used in a progressive and selective way by the IMT and in parallel with simpler manual techniques; so the answer is that both approaches remain valid. The point was strongly made by senior FMS staff, SDOs and RDOs that they do not expect perfect map renditions at all times, but do expect to receive critical information in map form in time to make effective decisions, especially during the early stages of the incident. Everyone agrees on the unique utility of maps for strategic appreciation of the fire.

The IMT concentrated on the production of maps showing where the fire actually was at various times which was an essential piece of intelligence, but these were not then used as the basis for fire projection maps. The reasons for this have been discussed elsewhere in the PIA and did not really have much to do with the mapping system or mapping capability.

The transmission of maps between the ICC, OP and SDO is as important as their production. There was no fax operating at Koorarawalyee for the reception of simple maps during the first few shifts, but maps were transferred from the OP to the ICC by email as pdf files and physically as hard copy in the IAP from the ICC to the OP by staff and crew movements. The lack of a large format printer at the OP limited the capacity to print maps and none were sent from the ICC by email for printing at the OP. The IC and

SDO were connected by all forms of electronic information transfer. Direct electronic map transfer from the helicopter was not available and this was unfortunate as the Air Observer was in a very favourable position to observe the fire. Communication with the helicopter was confined to mobile phone or briefings after flights. Maps were also made by the Operations team using PDF/GPS downloads from helicopter flights.

DEC has been developing a high capability fire communications vehicle (pantechnicon trailer) to complement the existing five fire communication buses (Toyota Coaster buses). The new unit will house a full suite of communications and IT facilities to be deployed to major incidents. See Section on Communications for more details.

Recommended Actions

1. IMTs will use all forms of map products in a timely way to inform the RDO, SDO, and other agencies.

2. The production of fire prediction maps will be given high priority by IMTs for all wildfire incidents.

3. Formal fire training and preseason briefings will emphasise the importance of taking a flexible approach to timely map production and explain the capacities and limitations of the existing and incoming new systems.

4. DEC will deploy the new communications vehicle with additional mapping facilities during the 2008/09 fire season for operational trials. The existing communications buses will be maintained and improved for routine incident management operations.

5. DEC will investigate the technical options for capturing and transferring graphical information from aircraft.

6. SDOs will give priority to dispatching GIS staff to fires with Level 3 potential as soon as possible in the first shift. Partial IMT deployments will include a GIS Situation Mapping Officer as the default dispatch.

7. Deployment should include a Situation Mapping Officer to the OP to gather and transfer information to the ICC and to assist intelligence flow at the OP.

8. DEC will investigate the practicality and cost of technology that is capable of mapping the fire boundary at night from the air (Line Scanner, FLIR, unmanned aircraft or similar) and seek resources to acquire such equipment.

3.11 Managing Road Traffic

3.11.1 Traffic Management

Debrief Issues

A striking aspect of the debrief discussions about the management of GEH traffic was the early and consistent recognition by the IMT of its central importance to the safe management of the fire. Similar importance was placed on the safety of firefighters, discussed latter in the PIA under 'Safety'.

This recognition was in keeping with the WTA-FPP that clearly identified the significance of the GEH in relation to wildfire in the Boorabbin area.

The following actions indicate the awareness of the IMT concerning safety on the GEH:

- At 1550 hrs on Friday 28 December, shortly after the fire was first reported, the IC phoned the police at Kalgoorlie to inform them there might be a road hazard from smoke on the GEH and requested a police car patrol the area to slow the traffic.

- On Saturday 29, four police officers were briefed at the OP by the OO on the fire situation to date and the potential need for roadblocks on the GEH on the following day. The OO made arrangements with the police to maintain contact through a designated police liaison officer.

- The PO commented in an IMT meeting at 1000 hrs on Sunday that if the fire escapes they would need to inform the police, MRWA and senior DEC staff immediately regarding closure of the highway.

- At approximately 1000 hrs on Sunday 30 the IC phoned MRWA's contractor to warn them that should the fire escape containment lines it could threaten the GEH and necessitate road blocks.

- Early on Sunday the OO, anticipating worsening fire conditions, arranged for extra warning signs to be placed on the GEH. These were confirmed to be in place at about 1000 hrs.

- On Sunday 30, at approximately 1145 hrs, the OO gave the police a briefing and spoke about the likelihood of a roadblock on the GEH. He asked the police to find the best location for a road block west of the access road into the OP.

- At the PO's direction, the SO phoned the police at Coolgardie at 1135 hrs regarding the need to establish road blocks and found they were already on their way.

- When the fire escaped the OO sent DEC staff to assist the police with the road block to the west of the OP. The OO requested the IMT close the GEH.

- At about 1325 hrs the SO attempted to phone the Goldfields Regional Police centre but did not realise the phone system automatically transferred the call to the Coolgardie police. The SO asked the police if they could attend an IMT meeting at the ICC. The police declined as they felt that it would be sufficient for them to be kept informed, presumably by phone. The Sargeant present at the western roadblock continued to provide liaison with the police in the field.

- At 1338 hrs on Sunday 30 DEC's information officer in Perth phoned MRWA regarding the situation on the GEH and sent the latest news update to them that included the GEH closure.

- At 1535 hrs, at the request of the PO, the SO phoned the police to confirm that their assistance at road blocks was appreciated and would need to continue.

- The IAP Situational Analysis prepared at 1700 hrs December 30, noted the safety hazard of smoke on the GEH and one of the aims of the fire suppression strategy to protect assets such as the GEH.

- At 2125 hrs on Sunday 30 the IMT discussed the escalating fire behaviour and the likelihood that the GEH would be closed overnight.

The road management strategy on Saturday 29 was to allow GEH traffic to pass through the fire affected zone provided they were not in danger from fire or smoke affecting the highway. The IMT was also aware of the potential hazard of mixing fire vehicles and crews with other traffic on the GEH. The main determinant of this strategy was the wind direction that took the smoke and fire front away from the highway in a northerly direction. The police had been advised of the potential for a smoke hazard on the GEH on Friday 28 and were briefed about the possible need for road blocks should the fire threaten the GEH again with a northerly wind change.

At the outset it was the general expectation of the IMT that the roadblocks would be maintained whilst the fire was uncontrolled and an immediate threat to traffic on the GEH. The SDO shared this assumption and took the view that even very severe fire behaviour near the GEH would not be a threat to traffic if travellers were prevented from moving into the active fire zone.

The position of the IC and OO changed during the afternoon (Sunday 30) as large numbers of vehicles accumulated at each roadblock. The roadblock at the western end being particularly problematic as there were no refreshment facilities and also conditions were extremely hot and dusty with a plague of flies in the area. Pressure from travelers in this situation mounted and this pressure was passed onto the OO and IC via the officers staffing the roadblocks and in some instances directly from travellers by phone.

The IC and OO discussed their options in the light of the increasing problems associated with a growing accumulation of traffic in very difficult physical conditions. Deliberations

over road traffic management was largely an operational matter for the IC and OO, and although it was commented on at an IMT meeting it did not fully involve the LO or PO as a collective IMT decision making process. Thus the LO thought the original strategy of a complete road block was still in place on Sunday evening and was surprised to find otherwise. This came about because the LO in particular was fully occupied on urgent logistical matters and somewhat separate from the command and control functions of the IMT and also because the issue was perhaps not as prominent as it might have been in IMT meetings. The frequency and formality of fully inclusive IMT meetings might also have played a part. The PO was aware of the evolving road management strategy and believed it was appropriately the prerogative of the IC and OO.

An alternative strategy that offered some respite to the impasse emerged when the Air Observer in the helicopter reported only intermittent fire exposure on the highway in the form of separate narrow tongues of fire running across the GEH as the remaining vegetation north of the highway spasmodically burnt out. After careful consideration, and under the close surveillance of the Air Observer in the helicopter, a number of convoys were escorted through the fire affected zone on the GEH.

Although there were some innovative aspects to the partial road block system, such as surveillance by the Air Observer and escorted convoys, the periodic lifting of road blocks on Sunday afternoon was in a sense a return to the strategy of Saturday 29 that allowed traffic to pass through the fire zone provided fire activity along the edge of the highway was mild, smoke did not excessively restrict visibility and the fire front was running well away from the GEH. The IC announced the IMT's intention to allow the passage of traffic through the fire zone if safe to do so in his press release at 0930 hrs on Sunday 30. This was a repeat of Saturday 29 that would prevail only as long as the winds and fire behaviour were favourable.

The convoys included escorts comprising police vehicles and DEC fire trucks to regulate the traffic flow and provide reassurance to the drivers. The convoys had to be one-way traffic to avoid the risk of collisions. As it turned out there were more west to east convoys and this caused considerable disaffection from those held at the eastern end at Coolgardie. All convoys passed through successfully and were individually monitored.

To relieve the mounting accumulation at the eastern end at Coolgardie the IC set up a target of 1800 hrs for the passage of these vehicles in convoy. The OO was somewhat reluctant to agree to ongoing partial roadblocks on Sunday night as the fire was still active, he was aware of the south west wind change in the general forecast and had concerns about the resourcing of roadblocks. He agreed after suggesting the placement of sentries as a safeguard against any development of the fire and accepted the prevailing expectation that the fire would generally die down overnight. He also took comfort from the substantial distance between the head fire and the GEH that he felt would give adequate warning time to the sentries. The OO directed the FESA officer to make an entry in his diary (OO's diary) to formally note the decision. The decision was shared with the police at the western roadblock and the two sentries.

At about this time (1900 hrs) the helicopter had to depart for Kalgoorlie to meet last light flight limitations and so the system of convoys monitored from the air was replaced by ground sentries placed at each edge of the fire where it crossed the highway. The idea was that these sentries would watch for any escalation in fire behaviour and if necessary close the highway until the transient danger passed. The advantage of sentries placed at the fire edge was the rapid response to fire changes and the minimization of vehicle passage time in relation to those observations. This was in contrast to convoys having to travel the 104 km from Coolgardie during which time the fire conditions could have changed.

The IMT was aware that it would be better to have the western road block moved further west to a place with facilities such as Yellowdine, or better still, Southern Cross, so that travelers could be better managed and cared for, as happened at the eastern end at Coolgardie. However, this option was difficult to execute as there were not enough police to give effect to a two stage manoevre that reduced the existing accumulation whilst also preventing more arriving. Macmahon informed the IC that they could only staff the roadblock at Coolgardie and could only open and shut the roadblock, not escort convoys. There were also groups of vehicles accumulated at Bullabulling and on the road between Bullabulling and the eastern edge of the fire. The upshot was that there were insufficient MRWA contractors and police to manage the roadblocks and convoys with any margin for unexpected contingencies or to shift locations efficiently. There was also a lack of support and services for stranded travelers languishing at roadblocks, particularly at the western end.

The IMT tried to make up for some of these difficulties by sending DEC staff to roadblocks to support the police and provide liaison. A FESA liaison officer joined the IMT at an early stage and contributed directly to operations in a number of roles, including traffic management on the highway. The IC and OO made sure the FESA liaison officer was fully involved in IMT activities, including a flight in the helicopter to facilitate his situational awareness. DEC fire trucks and crews were also active in escorting convoys with the police. DEC staff provided bottled water to travelers at the road blocks. These activities by DEC were a critical part of the management of the incident, but there was a general feeling at the debriefs from IMT members that they would normally expect the road management authorities and the police to handle most of the traffic issues and roadblocks leaving DEC staff relatively unencumbered to combat the fire. They fully acknowledged DEC's role in determining the risk management aspects of the fire and the stop/go decisions for traffic at road blocks and the importance of safely managing fire crews and units on and adjacent to the GEH in relation to other traffic. These responsibilities would pertain no matter how many resources other agencies supplied.

The IMT attempted to get sufficient resources for managing the GEH roadblocks and associated operations by tasking the MRWA contractor and the police at a local regional level. Both the police and Macmahon responded promptly, given that they were pre-warned of the need, but their resources were limited. The police suffered a loss of two officers redeployed to a traffic incident associated with a convoy and Macmahon were

not able to resource both roadblocks. Police reinforcements from the Kalgoorlie regional centre were apparently unavailable on Sunday. The guidelines in FPI 75 suggest that the call for road management resources be placed to central coordination centres such as Main Roads WA Traffic Operations Centre in Perth and the Senior Sergent at Police Communications in Perth. DEC's IMS also operates on a system of referral of requests for outside resources via the SDO, as had already been done several times for fire fighting and IMT resources. By focusing on local regional networks the IMT may have limited their scope to source extra resources from other authorities. The formal mechanism for co-opting and coordinating multi agency assistance is the Operations Area Management Group (OAMG) convened under the auspices of SEMC Policy 7 and WESTPLAN – BUSHFIRE.

The IMT also made efforts to inform the traveling public about road blocks and the status of the fire. Maps and statements were placed at service stations on the GEH. Messages were presumed to be passed on to MRWA by their contractors, Macmahon, and there was also direct contact with MRWA from DEC's media staff in Perth. DEC produced six media releases in the first three shifts that were widely distributed, including to the MRWA.

A key issue in these situations is the unity of the command and control process in the IMT, particularly with a critical safety issue such as managing the traffic on the highway. As previously discussed, the IMT was aware of the central importance of managing traffic on the GEH from the outset when the IC first took control of the fire. The matter was discussed in IMT meetings and all IMT leaders were aware of the roadblock strategy that initially was a simple indefinite blocking of the highway. The evolution of that simple exclusion system to a helicopter observation platform facilitated convoy system and ultimately a night time sentry method was progressively controlled by the IC and the OO who were in regular communication via phone. Whilst both were aware of their common strategies there did appear to be two centres of control and decision making, one at the ICC principally focused on the Coolgardie road block and the other at the OP that was particularly in communion with the police at the western road block. At the ICC, the IC made it known about 1400 hrs that he would henceforth undertake the liaison with Macmahon and the police regarding the roadblocks. This was done mainly to relieve pressure on the Planning Section and also because the IC had local knowledge and local contacts. It was also a reflection of the growing cogency of complaint from the accumulated traffic that the IC felt was his responsibility to manage. The planned decision to open the GEH at 1900 hrs was taken by the IC after consultation with the OO and phone discussions with the police at the road blocks. The IC felt the decision was entirely safe as the fire had been inspected by the helicopter at last light and current reports indicated the fire on the highway was quiet. He expected the convoys to be escorted by police with DEC and FESA sentries to guard the entry points near the fire. He expected the fire to remain quiet overnight, even in the presence of a forecast south west wind change. Should the fire reactivate to any degree, the sentries would be able to stop traffic entering the danger zone.

In debriefs, IMT members believed that they had followed the guidelines of FPI 75 (version 15/03/04) Closure of Roads Associated with Wildfire Suppression Operations and the related FPI 64 Roadside Signage and Safety at Burns and Widlfires, but felt the FPIs (now FOGs) did not cover all aspects of the situation they encountered.

The most common observation was that *'the FPI 75 told them how to close roads, but not how to re-open them'*.

The IMT responded appropriately when the HAZMAT situation occurred following loss of trucks on the GEH. The LO became aware of burning trucks by a telephone call from a bus driver going to pick up DEC staff, and he realized that the unknown load on the truck could be a HAZMAT issue. He immediately (2055 hrs Sunday 30 2007) phoned FESA via the 000 call and advised them of the situation. The OO removed DEC staff from the vicinity of the HAZMAT risk.

Coordination Group Review and Discussion

It is evident to the Coordination Group that the IMT thought the safety of traffic using the GEH was a primary concern in the management of the incident. Likewise the safety of fire fighters was also pre-eminent. Debriefs with all DEC staff at the incident, interviews with the IMT and a review of incident documents confirms that the IMT was intent on properly exercising their duty of care for those affected by the incident. The IMT recognized they had a primary responsibility as the HMA for decision making and management of the incident including the GEH. They also considered that they had a partnership in that exercise with the supporting agencies helping them to manage the GEH.

The IMT was also concerned about the comfort and convenience of travellers on the GEH, particularly considering the extreme weather conditions, lack of amenities at road blocks and the New Year holiday period. The IMT was aware of the importance of the GEH as the State's most important road transport route and the significance of the infrastructure services along the GEH corridor threatened by the fire.

The simplest strategy for the IMT to manage the GEH would have been a total road block for the whole duration of the incident. Indeed that was the initial strategy adopted when the fire escaped south across the GEH and even some members of the IMT and the SDO thought it was still in place on Sunday evening. A total exclusion strategy would have transferred much of the ongoing practical management of roadblocks to those agencies with the formal statutory authority for controlling road traffic, leaving the IMT and fire fighters able to concentrate mostly on suppressing the fire. As the HMA the IMT would still have responsibility for the welfare of travelers held at road blocks but would no doubt in time gain the assistance of other welfare agencies in this task. Following the fatalities, the ensuing IMTs reinstated the strategy of total roadblocks for the following nine days of the seventeen day incident. The ongoing road blocks attracted criticism from a number of GEH users and other interests who thought it was overly cautious and caused inconvenience and economic loss.

The IMT, particularly the IC and OO, were subject to substantial pressure and complaint from some of those delayed at road blocks, either indirectly through staff and agencies at road blocks relaying the pressure they were experiencing, or in a few cases directly by travelers phoning the IMT. Even in abstract, the IC and OO were able to identify with the situation of travellers held at roadblocks or being compelled to take long deviations. There was also a suggestion that there might be some 'leakage' around the road blocks that could be a cause for concern. Having acknowledged their good intentions, the obvious question is whether the IMT, particularly the IC and OO were unduly swayed by the personal pressures, direct and indirect, to let travelers pass through the fire ground such that they decided to take a higher risk than was judicious or their professional training and experience would normally advise. There is also the question of whether they conformed to DEC's standard operational guidelines and practices in these circumstances.

The Coordination Group believes that the heavy pressure on the IC and the OO to lift the road blocks did have an effect on their thinking to the extent that when a solution appeared in the form of reduced fire activity along the GEH as reported by the Air Observer in the helicopter and by ground crews and staff there was considerable incentive to adopt it. It seems in retrospect that this opportunity was almost an inadvertent discovery and was not the result of a definite intention to find a way to lift the road blocks because of the public pressure. On the other hand, it was in effect a repeat of the approach taken on Saturday 29 when the IMT allowed traffic to pass through the fire zone as the fire on the GEH was inactive and the fire front running away from the GEH well to the north. The difference on Sunday was that the weather conditions were more extreme and the fire was on both sides of the GEH but later was more like the situation on Saturday as the northern side of the GEH burnt out and the fire front ran well to the south.

The OO was quite reluctant to adopt the strategy of partial road blocks and demanded a very through inspection by the Air Observer at last light to be convinced the overnight convoy system would be safe. The earlier cautious and successful passage of some escorted convoys seemed to vindicate the new strategy and relieve what was certainly a fraught situation for those held in very unpleasant conditions at road blocks. It was probably also a welcome development for the agencies assisting with the management of the GEH who were struggling to maintain the road blocks and reply to the questions and complaints of delayed and frustrated travellers.

An influential aspect of these road blocks is that they 'captured' travelers close to the fire at Bullabulling, a small group immediately east of the fire and a larger group immediately west of the fire where facilities were limited or minimal. It was a very long retreat back to Coolgardie or Southern Cross and an even longer journey to take the official detour around the Boorabbin area. This may have prompted travellers to wait at road blocks in the hope that it was their best option for their ongoing journey. Once partial road blocks occurred and successful convoys commenced, the expectations of those at road blocks would be fixated on the resumption of their journey along the GEH. The IMT was

prepared to switch the road blocks on and off as observable and predictable fire risk dictated, and in fact did so. However, they expected that the prospect for a successful continuation of the partial road blocks overnight was good as they considered the fire risk would continue to abate during the night.

Having considered the records of the incident and discussed their intent and decision making process with the IMT, particularly the IC and OO, the Coordination Group has come to the conclusion that the decision to open the GEH on Sunday afternoon/evening was influenced by the pressure on the IMT, but this pressure did not prejudice their decision making as it was clearly founded on a conscientious risk assessment based on real fire behaviour evidence and conformed with their genuine expectations of overnight fire behaviour. It was also in effect a repeat of the open highway strategy on Saturday 29 that similarly employed the precaution of police readiness for road blocks and traffic management.

The second question is whether the IMT's actions also conformed with DEC's standard operating guidelines and procedures.

The IMT had two documented guidance procedures that relate to the management of traffic on the GEH. Clearly FPI 75 Closure of Roads Associated with Wildfire Suppression Operations directly addresses the issue. The ICS 1.1 Situational Analysis – Background and Objectives covers 'Values at Risk' and 'Safety Risks and Hazards' which contribute to 'Incident Objectives'. The role that both of these processes played during the incident is instructive.

The IMT was clear that they were to manage the road traffic according to DEC's FPI 75 and that DEC was the Hazard Management Authority and therefore had responsibility for conducting the risk assessment that closed or opened the GEH. There was no ambiguity about this. However, the IMT did see the actual physical management of the traffic as a joint agency responsibility, with the Police and the MRWA taking lead roles in their own right. The IMT expected that once the roadblocks were set up they would then be able to concentrate their resources and efforts on containing the fire and making the necessary risk assessments to determine when the GEH could be reopened.

The IMT started the blocked GEH phase of the fire on Sunday 30 with the expectation that the GEH would remain closed for the duration of the fire or until the fire was safe and no longer a threat to passing traffic. This simple total exclusion model was shared by the SDO who consequently thought that the risk to totally blocked-off traffic on the GEH was zero.

This simple but effective plan changed for a number of reasons, but there were two main reasons why the total exclusion plan was converted to a partial road block.

The first was that the build up of traffic contained at road blocks was not being managed adequately in a number of ways. The primary problem was that there was no 'exit strategy'. The full extent and impact of the road blocks had not been thought through so

there was no satisfactory message for those people waiting in very adverse and trying conditions at the road blocks, particularly at the western road block where there were limited facilities. As pressure mounted from exasperated travelers, the police attempted to obtain some kind of indication from the IMT as to the message they could give to the waylaid travelers, preferably some hope of continued passage. The IMT was not really in a position to give any prognosis for lifting the road blocks as they were in defensive mode with crews withdrawn to safe zones, downed powerlines, smoke on the highway, tongues of flame across the highway, and the fire running very fast south under extreme conditions with no effective containment measures. The IMT did try to stem the traffic build up by producing media releases, posting information at service stations and by informing MRWA via DEC's Perth media officer but by that time there was already a substantial accumulation of vehicles at roadblocks.

The prospect of an alternative traffic strategy was first noticed by the Air Observer in the helicopter, who with a birds eye view of the fire, could see a pattern of mild fire along the GEH and was able to detect any flare up still coming from the north or in unburnt pockets along the highway. This observation presented itself as a possible solution to the growing impasse at the road blocks and was adopted by the IC and OO subject to very focused and continuous aerial observation and a safe convoy configuration escorted by police, a FESA officer and DEC fire fighting staff and vehicles. The system worked and the most disadvantaged traffic at the western roadblocks was given priority for escorted passage.

Another problem, as briefly mentioned above, was that travellers were inadequately provided with services and supplies, particularly at the western end. Travellers at Coolgardie had access to the town's facilities. The 'roadblock authorities' were under prepared and under resourced to deal with any protracted roadblock in terms of supporting the stranded travellers. The IMT saw the facilities predicament and sent bottled water to the roadblocks. The police did not have sufficient resources to shift the western roadblock back to the better location in the town of Southern Cross but did manage to move it back to Yellowdine leaving a small group of vehicles at the road block near Koora.

A routine aspect of roadblocks on major routes is for the MRWA to organize a safe bypass route so travelers have the option of waiting or departing. This was done with a bypass route via Esperance to the south and Merredin to the west, a substantial extra distance that may have caused travelers and truck drivers to wait in hope that the GEH would be opened. Once convoys through the fire ground commenced, the bypass route would have seemed even less attractive and an escorted convoy would have become the expectation of waiting travelers. The favouring of the west to east flow of convoys because of the limited amenities at the collection point, exacerbated the tension for those waiting at Coolgardie 104 km to the east and became a problematic focus for the IC.

The underlying coordination problem for the IMT and the road management authorities was they were not all working to the same set of documented guidelines for handling the situation. The IMT was following FPI 75 that gave guidance on the initial setting up of roadblocks and the handing over to road management authorities, but did not tell DEC

staff how to partially run or support roadblocks, deal with traffic management or assist stranded travelers. FPI 75 describes the ongoing management of roadblocks as the prerogative and responsibility of the road management authorities and therefore did not provide for a major role for DEC other than the initiation of the action and the conduct of the risk assessment process for the fire suppression operation that would determine the duration and location of roadblocks. When it became apparent to the IMT, particularly the OO, that the road management authorities were under pressure, they provided DEC officers and fire crews to assist with liaison and convoy escort. Both the police and the IMT at the ICC and the OP made sure that they had effective lines of communication and the OO personally gave the police briefings at the OP. So, to their credit, the IMT did do their best to support the police and Macmahon in their tasks and did not relegate it on the basis that they were only the fire combat agency. They also attempted to inform the police and Macahon by approaching their regional offices. It transpired that Macmahon's capacity did not extend to the western side of the fire and their role was limited to simply blocking or opening the road on instruction, and could not do any convoy escort duties. Even this limited capacity was constrained by Macmahon's staff availability at that time. DEC is unaware of the documented procedures MRWA had in place for this eventuality or those that the police might have been using.

The other documented guideline that should help with the management of traffic safety on the GEH was the IMS IAP, specifically ICS form 1.1 Situation Analysis – Background & Objectives that covers safety hazards and risks that are considered in forming the Incident Objectives. Indeed the IAP produced on Saturday 29 for the Sunday 30 shift picked up the GEH hazards and safety issue and translated them into precautions for fire fighting crews and roadblocks for travelers on the GEH. The fire combat safety precautions are clearly 'owned' by the IMT and executed through the OO under the instructions of the IC. They take the form of personal briefings of crews by the IC and especially the OO and are also captured in the IAPs given to Sector Commanders and Crew Leaders. The same procedure is repeated on the fire line at sector level. Many of the warnings in the IAP automatically trigger a number of actions that fire crews are trained to do, such as identifying escape routes and safe zones, watching out for the infamous 'dead man zone', keeping a close eye on fire behaviour and weather, maintaining communications and a number of other responses. However, in the case of the safe management of traffic on the GEH, there was really only one option initially and that was total exclusion. Also, the job of doing this was expected to be the responsibility of the road management authorities.

The IMT, as expressed in the IAP, principally looked inwards towards the wellbeing and safety of fire fighters with the expectation that the safety of road traffic will automatically be assigned to the road management authorities. This reflects FPI 75 that is a relatively simple 'handover formula' compared with the sophisticated and extensive in-depth approach to the safety of fire fighters in DEC's IMS. Another manifestation of this customary approach is the appointment of a Safety Officer who answers directly to the IC and is concerned with the standard prescribed safety measures on the fire ground and en route to the fire ground that keep fire fighters safe. In a similar way, someone examining DEC's IMS might think that the item described as a 'Transport Plan' was relevant to

managing traffic on the GEH, but in fact it simply aims to plan, organize and facilitate the movement of fire fighting and supporting vehicles on and to the fire ground. Thus, when the Coordination Group mentions a 'traffic plan' that would comprehensively cover all aspects of managing the GEH, it is really referring to an innovative planning process customized by the IMT to the Boorabbin situation rather than a standard IMS formula or documented procedure. In the event, a 'traffic plan' as such was not produced during the first three shifts of the incident.

Whereas a total roadblock can be seen as an implied outcome from the application of FPI 75 and the ICS hazard management process, both of these guiding documents are silent on any further road management options such as a partial road block and certainly say nothing about how to conduct them. Even the business of fire risk assessment for road blocks, clearly accepted by DEC IMT's as their HMA responsibility, is not set out as a traffic management procedure, but is subsumed into the general Situational Analysis of the IMS. So the IMT was not well equipped with documented procedures to deal with a complex high order traffic management problem that they expected would be fully organized by the road management authorities. The one remedy the IMT had, that is documented in FPI 75, was to report the problems and call for assistance from outside the region. Unfortunately by the time the rapidly escalating, stressful and demanding situation on Sunday afternoon demonstrated that the IMT needed help, it could not be provided until the next day.

In addition to the lack of a single integrated documented guideline for all agencies the organisational coherence and leadership of the operation was too locally focused and a little disjointed despite the earnest efforts of the IC and IMT to connect and work with the right people.

The State emergency management system operates through a district, region and State structure that provides a graduated response to incidents. The graduated response is gauged by the level of the incident; Level 1, Level 2, Level 3. The State Bushfire Emergency Management Plan (WESTPLAN – BUSHFIRE) states that Level 1 and Level 2 incidents are usually managed locally and regionally by the HMA but Level 3 incidents may require the establishment of an Operations Area Management Group (OAMG). The OAMG for an incident such as the Boorabbin fire would typically comprise a senior officer from the HMA (in this case DEC), the regional police officer in command, FESA, the local Shires, MRWA, utilities such as Western Power, Telecom, WestNet Rail, Water Corporation, and supporting agencies such as the SES and Department for Child Protection. A subsidiary technical support group called an Incident Management Group (IMG) comprising operational people from the relevant agencies can also be set up to assist the IMT with practical field matters. The IC and IMT did connect with many of these organizations in a timely manner and maintained effective communications with them, but fell short of formally establishing an OAMG or IMG, The regional FESA officer participated from the outset in liaison and operational roles with DEC staff.

It was a misjudgment to not forcefully press the requirement for the physical presence and commitment of regional managers of other key agencies such as the police and

MRWA at some IMT meetings. The best way for an IC to press the point with other agency leaders is to formally declare the formation of an OAMG and IMG. At the Boorbabbin incident the trigger for the formation of an OAMG and IMG would have been the incident becoming Level 3 when the fire escaped south across the GEH on Sunday 30. It is arguable that the list of trigger mechanisms in WESTPLAN – BUSHFIRE suggest that the blocking of a major route such as the GEH might of itself be sufficient reason to form an OAMG and IMG. Furthermore, the assets already under threat from the start of the fire, such as the power lines, water pipeline, pumping stations, Telstra facilities and rail line, might have been seen as a trigger for an OAMG and IMG from the outset. The value of an OAMG and IMG would have been that the IMT received the benefit of the knowledge and support of other senior regional agency personnel and it may well have encouraged them to resolve their prioritization or resourcing issues by calling for assistance from their respective Perth - based central offices. The other oversight of the IMT was to not call for more centrally coordinated organization of resources from other agencies via the SDO when their local approaches were not fully resolving matters. Similarly, the SDO did not see a need to prompt an OAMG and IMG until he elevated the status of the incident to an effective Level 3 when it escaped across the GEH. His decision complies with the accepted trigger mechanisms in WESTPLAN – BUSHFIRE in terms of the progression to a Level 3 incident, and the issue therefore becomes more a question about why the strategic appreciation of the incident was progressive through Friday, Saturday and Sunday rather than seeing Level 3 potential from the beginning. This subject is dealt with elsewhere in the PIA.

In the context of traffic management at Boorabbin, the Coordination Group expects that in similar circumstances an OAMG and IMG would bring a more intense and coordinated focus on the management of roadblocks, better support for stranded travellers, and adequate expert and effective resourcing of all elements of this critical part of the operation. An OAMG/IMG would be expected to not only marshal the necessary resources, but also to assist and even prompt the IC to develop a longer term plan for traffic management. Issues such as staffing overnight shifts, moving roadblocks, providing information, supporting travellers and providing convoy escorts would be incorporated into a jointly prepared Traffic Management Plan and adopted by all concerned.

In hindsight, the Coordination Group suggests that the main problem with the management of road traffic was that the task was initially under estimated by the IMT and not fully appreciated by others involved at the regional level of the road management authorities. The central offices of the road management agencies involved did not seem to be aware of the potential of the problem, presumably because they considered it to be under control at a local level. DEC is not aware to what extent the central offices of other agencies were informed by their regional offices. When it became manifest to the IMT and local road management authorities on the job that they had a problem, their efforts to remedy the difficulties within local regional resources fell short of requirements. It needs to be remembered that all of this happened in the course of one afternoon and became acute very quickly on the GEH because of the arterial nature of the GEH, the incoming large numbers of vehicles including large trucks, the lack of a convenient detour, the

short time for warning or re-routing oncoming traffic, the lack of facilities, the extreme weather conditions and the pressure of the holiday period. There was a conjunction of misfortunes.

Again, with hindsight, it is evident that the Boorabbin incident really comprised two critical operational components; the first was the management and suppression of the fire and the second was the management of traffic on the GEH. The Coordination Group feels with retrospective wisdom, it might have been more appropriate to regard the Boorabbin incident as primarily about the management of the GEH with the suppression of the fire almost being a secondary function as a 'traditional' chase of an extensive GFR fire that is eventually contained by persistent targeted suppression action and the obstacle of natural low fuel areas. That is not to say the IMT at any stage disregarded the importance of the GEH, but it is natural for the DEC IMS to see fire containment as the pre-eminent objective in the IAP and the GEH as a safety management issue rather than the primary strategic objective. The view that the management of the GEH is pre-eminent does not mean that DEC would be required to do all of the work on traffic management, but it would mean that the GEH (and other infrastructure assets) would feature as the main game in the IAP in the form of a traffic plan developed in consort with the relevant road management agencies. It also means that Situational Analysis in the IAP would be focused on pivot points (eg shifts in wind direction) that might be significant for the management of the GEH and be the key component of a formal risk assessment determining the road blocks.

Another way of dealing with the GEH in the IMS is to make the highway a functional Division of the incident (a Division is a group of Sectors or a major area of operational function) in its own right, with a Divisional Commander and resourced accordingly. This approach would be complicated by the fact that the road management authorities were in charge of the road blocks, but with appropriate arrangements the two parties would be able to work together under a Divisional structure. The benefits of a GEH Division would have included full integration into the IAP and the fire containment operation with detailed sector plans that could in effect be a surrogate Traffic Management Plan. The IMT did in fact do this as indicated in the sector map prepared at 1957 hrs on Sunday, but it did not receive the resources it needed to operate fully as a Division with a specific set of objectives in the IAP. It did later.

Notably, when the full PFT and Level 3 IC arrived at 0730 hrs on Monday 31 an OAMG was set up with the Regional Manager assisting in the liaison role from 1 January 2008. The overnight tragedy stimulated intense public attention to the fire and a SECG was called and the State's entire emergency management system at all levels came into effect. Had the tragedy not occurred, the Coordination Group believes the OAMG and IMG would still have been called by the full PFT in the normal course of events as it was now unquestionably a Level 3 fire and the ongoing blockage of the GEH a persistent major issue. The fire was gaining ground and with a very large perimeter was going to need an extended effort for at least a week to render it and the GEH safe. The cooperation of all relevant agencies was required at a local and central level and the Coordination Group has no doubt that would have happened in the usual way in the ongoing Level 3 phase of

the fire. In retrospect it is evident that the extreme speed of development of the fire with two crossings of the GEH in ten hours outpaced the reinforcing of the IMT and was out of sync with the additional support and resources the road management authorities needed.

The remaining question is *'what difference might a fully resourced and functional traffic management system, operating under the prevailing guidelines, have achieved with respect to producing a different outcome'?*

Given that the escalation of the fire fanned by the south west wind change was not accurately predicted, would more police, Macmahon's staff or DEC and FESA liaison staff have made a difference? With respect to the placement of the sentries the answer is probably *'no'* because unless the wide head fire frontal advance had been accurately predicted and projected back onto the GEH the sentries would not know where to set up in relation to the fire danger zone. That is why they logically set up at the outside edges of the existing fire where it crossed the highway and in the case of the eastern side found themselves well inside the rejuvenated fire zone when the fire front emerged onto the GEH well to the east. This means that vehicles coming from the east would still have been in the dangerous fire zone when they reached the sentry. The lesson is that accurate and timely fire prediction and projection determines the placement of sentries, roadblocks and fire fighting crews. Additional police would have allowed greater capacity to ensure all convoys had full escorts during the night, including any necessary provision for shift changes and logistical support. If the sentries had been accompanied by additional officers, in effect making it more of a roadblock 'station' than just a one man sentry, there may have been sufficient resources for the position to be staffed at all times and not temporarily vacated when they escorted convoys through the fire ground or responded to an emergency. Aside from the previous point, it is not clear whether additional escorts would have helped as it may simply have meant that the escorts also became trapped within the fire zone. They may have been able to do something to alleviate panic or help traffic, particularly truck drivers, extricate themselves from the fire zone but the information needed to draw such conclusions is probably only known to the police investigators.

It would appear in retrospect that the intended overnight GEH 'roadblock' system was underdone and really needed to maintain at least what was in place during the day even if it was expected that traffic would largely flow freely through the fire zone. It is an example of the prudence of a worst case scenario approach particularly in the absence of an adequate guideline for managing such roadblocks. Night time roadblock operations have positives and negatives. The positives are that there is usually less traffic and less fire activity. The negatives are that visibility is low, readily made worse by drift smoke, and fire intelligence is limited (no aircraft) to foreground observation. Even small flare ups of the fire along the road can be more intimidating at night for drivers unfamiliar with fire and escape options are less evident. When setting up overnight roadblocks these different risk factors need to be considered and may not afford the option of reduced overnight resourcing. In this vein, more resources would have also provided for the eventuality of another accumulation of travelers that needed amenities, supporting

comforts and information. From a logistical perspective suitable portable lighting, reflective signs, reflective vests and other night time material provisions would also be pertinent for effective operations and safety.

In summary, the Coordination Group concludes that the IMT's decision, IC and OO in particular, (in consultation with FESA and Police) to allow traffic through on Saturday, permit partial escorted convoys on Sunday afternoon with helicopter surveillance and sanction continued overnight convoys with sentries, was not in conflict with DEC's standard operating procedures (FOG 75) and was cogniscent of the assumed fire risk. It was primarily done to convenience the traveling public experiencing very difficult circumstances and to alleviate resourcing deficiencies for ongoing road blocks. It is a more common practice for DEC to maintain complete roadblocks at fires (usually in the South West regions) as a conservative option. The exception at Boorabbin relates to the special circumstances that applied there in relation to the significance of the Great Eastern Highway, the prevailing difficult conditions for travelers and operational constraints. The guideline in FOG 75 for notifying central authorities was not followed, probably because of the pace of development of the situation on Sunday afternoon, perhaps also reflecting inexperience by the IC in handling what had become a Level 3 incident and unfamiliarity with OAMG procedures. These vulnerabilities were compounded by the IC's natural instinct for resorting to his local networks and resources. It should be remembered that GFR Fire 13 was out of all proportion to anything that had previously occurred in GFR fire management experience and was therefore not a practiced or familiar operation. The adversity of the outcome was primarily due to an erroneous risk assessment of fire behaviour, rather than an irregular or incorrect process of road traffic management. Having said that, it should also be acknowledged that a more comprehensive shared road block guideline that encouraged conservative risk assessment and sanctioned sustained road blocks would have assisted all involved in managing the GEH and might have made a difference to the outcome.

Recommended Actions

1. A Vehicle Control Point (VCP) Guideline that is common to all agencies involved in road traffic management at bush fires will be prepared. The Guideline must cover all aspects of establishing, managing and dismantling VCPs with clear designation of responsibilities and prescription of procedures. Guidelines For The Operation Of Road Closures During Bushfires has been completed for use during the 2008/09 fire season. The agencies participating in the drafting of the VCP Guideline include WAPOL, MRWA, FESA, DEC, and representatives of local government.

2. The VCP Guideline will cover community support and welfare procedures for travellers collecting at VCPs.

3. The VCP will deal with the role of the risk assessment procedure by the HMA that determines the establishment, management and dismantling of roadblocks.

4. DEC will review and improve FPI 75, now appearing as FOG 75, to cover the lessons learnt from Boorabbin and to mesh seamlessly with the new VCP Guideline. In particular FOG 75 will instruct DEC IMTs on the calling, establishment and risk assessment processes that determine the opening and dismantlement of road blocks. DEC staff will have clear guidance on their HMA responsibilities and those of other agencies and how they work together. An emphasis will be placed on notifying the appropriate contacts within other agencies involved in VCPs.

5. DEC staff will be trained in the use of FOG 75 and the VCP Guideline prior to the 2008/2009 fire season and subsequent fire seasons. Any necessary equipment will be procured.

6. DEC's IMS procedures and documentation will be amended to accommodate the provisions of FOG 75 and the VCP Guideline. DEC staff and IMTs will be trained in the use of the changes made to the IMS.

7. DEC will examine the application of FOG 75 and VCP Guideline to DEC's prescribed burning operations that might affect public roads and make appropriate adaptions to procedures for prescribed burning.

8. DEC will recommend the establishment or improvement of roadside rest areas on the GEH and other major highways to MRWA through the auspices of the State Emergency Management Committee (SEMC) that might serve better VCP arrangements in the event of wildfires near highways in remote areas.

3.12 Interagency Operations

3.12.1 Agencies at the Fire

Debrief Issues

The IC instigated a multi agency response to the incident at an early stage when he phoned the police at Kalgoorlie at 1550 hrs on Friday 28 December. At 1700 hrs the IC spoke to a Coolgardie Shire officer at the fire and at about 1730 hrs he spoke to a Goldfields Region FESA officer who joined incident management in a liaison role. A little later the IC spoke to Western Power in relation to an outage on the 220 kva powerline affected by the fire. At approximately 1000 hrs on Sunday 30, the IC contacted the MRWA contractors in Kalgoorlie, Macmahon, to warn them that there might be a requirement for traffic management and road blocks if the fire threatened the GEH that day. The police attended the OP on Saturday 29 and Sunday 30 and were in contact with the OO by phone.

Media releases by DEC were made at 1830 hrs Friday 28, 1030 hrs Saturday 29, 0930 hrs Sunday 30, 1230 hrs Sunday 30, 1630 hrs Sunday 30, 2000 hrs Sunday 30. At 1338 hrs

Sunday 30, the current media release was sent to the MRWA in Perth. The police in Kalgoorlie informed the Situation Officer around 1340 hrs that the police had been talking to Radio West about the road blocks.

At about 1550 hrs on Sunday it was confirmed in the IMT that St. Johns Ambulance would be available the next day.

The Bureau of Meteorology was asked to provide spot forecasts and did so at the requested times.

At 2135 hrs Sunday 30, DEC's media officer advised the IMT that the police State Duty Officer had been informed of the incident in which a truck driver suffered burnt hands and that the highway had been closed due to escalated fire behaviour.

The IMT appears to have confined their communications to local regional agency representatives rather than conferring with Perth-based agency centres, either directly or through the SDO. The media releases were known to go to a public audience. The IMT communicated regularly with DEC officers in Perth.

An Operations Area Management Group (OAMG) was set up on Monday 31 December. The OAMG comprised the DEC IC and supporting staff, WAPOL, MRWA, City of Kalgoorlie – Boulder, Shire of Coolgardie, Yilgarn Shire, Water Corporation, Telstra, Westnet Rail, Western Power, Department of Child Protection. Although the DEC IC attended in this case, the usual process is for the HMA to appoint an Operations Area Manager (OAM) to chair the OAMG.

The debriefs concluded that the OAMG process was very effective in coordinating the supporting agencies and assisting DEC once it was established. A SECG was established in Perth on December 31. Participating agencies were WAPOL (chairperson), MRWA, Western Power, Department of Premier and Cabinet, FESA, Water Corporation, Bureau of Meteorology, West Australian Local Government Association (WALGA) and DEC.

The IMT worked well with local agencies on critical issues like the switching off of live power lines that were down so they would not be a hazard to fire fighters. Western Power, Telstra, the Water Corporation, Westnet Rail were consulted about the risk to and impacts on their infrastructure and they responded in various ways. MRWA was represented by Macmahon and they were involved from an early stage. In debriefs the IMT felt that the local agencies were cooperative and supportive but in some instances had limited resources available that reduced their capacity to do everything the IMT might have wanted. This was most notable with Macmahon and the police who responded early and to the best of their ability at the time, but were restricted by their resources. The issue of limited resources was probably simply a fact of the matter with the holiday period and other staff absentees, but might also have been a problem of prioritization. The police had other issues to deal with and may not have fully appreciated the demands placed on their units on the roadblocks or the potential danger. Like DEC's SDO, they may have felt that the situation was safe if GEH traffic was totally blocked.

The IMT for their part attempted to get police attendance at the ICC but acquiesced when the police declined because they were busy. The police district staff thought that the situation could be managed by updates and the IMT keeping them informed of developments. This suggests the police and Macmahon and MRWA were in a reactive mode and dependent on DEC leadership rather than a proactive approach based on their own SOP for a major highway traffic management operation.

The view emerged from the debrief process that the IMT had engaged local agencies in a timely way that proved to be effective for many of their functions, but struggled to furnish the adaptability needed at roadblocks or to adequately look after the accumulated traffic. In retrospect the main issue was that the IMT relied too heavily on its local contacts with regional agencies and did not press them to export their resourcing problems for resolution at the State level of their respective organizations. The most orthodox and effective means the IMT could use to do this is to call an OAMG. An alternative would have been for the IC to request DEC's SDO to make the resourcing request centrally.

There was a distinct contrast between the extensive DEC resources drawn from outside the GFR and the other agencies relying on local resources.

Coordination Group Review and Discussion

The Coordination Group agrees with the points that emerged from the debriefs that the IMT did a sound job of using the local network of agencies and supporting organizations in a timely way that addressed immediate problems. In forewarning Macmahon and the police the IMT was anticipating the next shift problem of managing the GEH should the fire escape south. The deficiency in the process was to not make a longer term appreciation of the interagency support required and therefore make stronger demands for more resources as the pressure mounted on Sunday.

Again, to put this in context, the escalation of their needs occurred very quickly over the short period of Sunday afternoon.

The Coordination Group also agrees in hindsight that it would have been prudent, although unprecedented in the GFR, to call for an OAMG and IMG on Saturday in anticipation of the fairly predictable risk of a major traffic congestion problem on the GEH and also because of the known threat to 'lifeline' infrastructure in the corridor adjoining the GEH. It was the role of the IC and IMT to foresee this need and to trigger the formation of the OAMG/IMG. DEC's system of duty officers also provides supporting backup and advice for IMTs and a conduit for access to senior DEC staff and other agencies. The SDO was the pivot in this linkage as the Goldfields RDO had become the IC. The SDO was very attentive to the needs of the IMT and used his initiative and experience to ensure they had sufficient resources, including non-standard technical elements that as far as he could see matched or exceeded their needs. There is no automatic trigger mechanism that tells the SDO to query the need for an OAMG or IMG, it is a matter for judgment based on Level 3 fire parameters as described in SEMC Policy

7 and WESTPLAN BUSHFIRE. As far as the SDO was concerned these trigger points were not reached until the fire escalated to Level 3 when it broke away to the south on Sunday 30 and there was a major blockage of traffic on the GEH. His response was to upgrade the IMT with more resources and put a Level 3 IC in place (himself), these resources were only deliverable the next day. On Sunday evening he discussed the prospect of an OAMG with the IMT but it was not a practical proposition until the next day. On Monday 31, the replacement SDO requested the IMT establish an OAMG/IMG.

It is possible with hindsight to form the view that the potential of the incident to become Level 3 and therefore need an OAMG was discernable on Saturday based on fire prediction and projection of its path that would once again threaten the GEH and associated infrastructure. It is even possible that with exceptional foresight an OAMG and IMG might have been anticipated on Friday based only on assets at risk in the vicinity. This then becomes a question about the efficacy of DEC's fire declaration system (FOG 83) in these circumstances and to what extent it should have led the IMT and SDO to declare Level 3 fire potential at the outset. This has been discussed elsewhere in the PIA. The logical path of this enquiry suggests that within the DEC system FOG 83 is the prime mechanism for triggering an OAMG/IMG and it should complement and reflect the criteria in SEMC Policy 7 and WESTPLAN BUSHFIRE for establishing an OAMG and IMG. As has been said many times in this PIA, in the future ICs and SDOs will still have to use their experience and judgment in assessing the situation for each incident and seeing the need for or benefit of an OAMG and/or IMG, particularly where the incident is currently less than Level 3, rather than just following a fire declaration formula. Looking back over the history of OAMGs and IMGs it is acknowledged that their use is a relatively recent innovation, particularly OAMGs, that tends to be somewhat subjective and determined by the circumstances of the incident rather than rolling out as an automatic part of the AIIMS IMS. In fact, they have only ever been established in the south west areas (Perth to Albany) and only when the incident had already attained Level 3 status. The Boorabbin fire is the first time an OAMG has been used for a wildfire in the GFR.

In summary, the Coordination Group feels that it is possible that an IC with more experience of OAMG's (typically a Level 3 IC) might have called for an OAMG earlier. The SDO, who is a Level 3 IC, might have seen the need for an OAMG earlier if the fire assessments had not been reasonably optimistic of stopping the fire on Saturday or Sunday and masked the risk of it developing into a Level 3 incident as defined by FOG 83. The Coordination Group believes that even with a revised FOG 83 it will be necessary to impress on ICs and IMTs that they should not be reticent about calling an OAMG for fear of over reacting, as at the very least it will serve as a forum for ensuring all relevant agencies are well informed. The same point applies to IMGs in an even wider context and does not require the Level 3 trigger. The only criteria for an IMG is usefulness.

The above comments are inward looking towards DEC's people and procedures for inter agency operations. SEMC Policy 7 spells out that there is a degree of mutual responsibility between relevant agencies for teaming together to fight bushfires, even

when only one, like DEC, is clearly the HMA. A compelling reason for this model is that other agencies such as the MRWA and police have unique authority under their Acts, the Emergency Management Act and associated policies. To do this effectively each contributing agency has to have suitable SOPs and training in place to execute their roles efficiently. This PIA is unable to make any comment on what SOPs the MRWA, Macmahon, the police or the other supporting agencies were using to guide them in their roles for assisting the IMT at Boorabbin and to what extent they should take responsibility in their own right for non fire fighting functions. What can be said is that all combat and supporting agencies should be very proficient in the execution of SEMC Policies and WESTPLAN BUSHFIRE. It is starkly clear in this PIA, and no doubt to other relevant authorities involved at Boorabbin, that the principal lesson of this unfortunate incident is the absolute need for a comprehensive and universally applied guideline on vehicle control points and traffic management that all agencies actively adopt. The OAMG system will greatly assist the application of a common vehicle control point guideline by coordinating the agencies participating in an incident so they marshal the requisite resources in a timely manner and cooperate effectively.

The IMT was very clear that the responsibility for traffic management on the GEH was with the HMA (DEC) and that DEC was the decision maker on all aspects of the management of the incident. The IMT also recognized the onerous responsibility for undertaking the risk assessment on the incident that determined other actions such as opening and closing the GEH.

Recommended Actions

1. A whole of Government Vehicle Control Point Guideline must be prepared and actively adopted by all relevant agencies.

2. DEC will recommend through appropriate forums, that other agencies involved in bushfire incidents have the necessary SOPs and training to enable efficient participation in AIIMS IMS actions where DEC is the HMA.

3. DEC will review and improve FOG 83.

4. DEC IMT staff and DOs will be trained to implement the revised FOG 83.

5. DEC IMT staff and DOs will be retrained in the SEMC Policy 7 and emergency management arrangements, particularly WESTPLAN BUSHFIRE.

6. DEC DO staff will establish OAMGs and DEC IMTs will establish IMGs in accordance with FOG 83 and WESTPLAN BUSHFIRE.

7. SDO's will provide advice to DEC ICs on when and how to call an OAMG for all Level 3 incidents.

8. Preseason planning will include the documentation of all information required to quickly and efficiently establish an OAMG or IMG. The IPRP will include the necessary contact information.

9. Regional Managers with the assistance of their Fire Coordinators will be encouraged to make personal contact with the key agency managers that comprise their local OAMG prior to each fire season.

10. DEC regions will participate in any joint training or exercises conducted by other agencies to foster OAMG preparedness and efficiency. Where necessary, DEC will instigate such initiatives through the District Emergency Management Committee (DEMC) and the Local Emergency Management Committee (LEMC) processeses.

11. DEC will actively participate in all relevant OAMG activities and deliver any promised follow-up actions for OAMGs.

3.13 Public Information

3.13.1 Information Provided to the Public

Debrief Issues

The IMT adopted several measures to keep the public informed about the incident and its impact on the GEH.

Early notification of the fire by DEC to police and the MRWA contractors would have enabled them to alert their own systems of public information. The police at Kalgoorlie informed the IMT at 1330 hrs on Sunday 30 that they had spoken to Radio West about the roadblock.

The DEC Principal Communications Officer (PCO) based in the Public Affairs Branch in Perth responded to the IMT by producing a series of draft Media Releases and provided an updated media statement (1200 hrs version) to MRWA in Perth at 1338 hrs on Sunday 30.

The DEC media statements are as follows:

- Fire Media Statement 1830 hrs December 28

- Fire Media Statement Update 1030 hrs December 29

- Fire Media Statement Update 0930 hrs December 30

- Fire Media Statement Update 1230 hrs December 30

- Fire Media Statement Update 1630 hrs December 30

- Fire Media Statement Update 2000 hrs December 30

- (Other media statements were made after December 30)

About midnight on December 30 after the fatalities had been discovered the police in Kalgoorlie told DEC's PCO that they would handle the media outputs henceforth.

DEC's media releases progressively covered the following topics:

- Location of the fire
- Cause of the fire (unknown)
- Forces in attendance – periodically updated
- Size of the fire – periodically updated
- Weather forecast – current conditions
- Weather forecast - outlook
- Assets threatened
- Assets affected
- Hazards on the GEH
- Alert to motorists
- Possible convoy escorts – 0930 hrs Sunday update
- Possible periods of road closure – 0930 hrs Sunday update
- Notification of GEH closure – 1230 hrs Sunday update
- IC mentions 'southerly change for later this afternoon' – 0930 hrs update Sunday 30
- IC mentions 'southerly change expected later this afternoon' – 1230 hrs update Sunday
- IC comments on the significance of the south-westerly change – 1630 hrs update Sunday
- IC comments on escorted convoys and fire safety and aims to open highway at about 7pm
- IC says west bound traffic open and east bound open by 8pm – 2000 hrs update Sunday
- IC says southerly wind change due at around 8 pm – 2000 hrs update Sunday
- IC says fire could run with southerly gusts so motorists to take extreme care – 2000 hrs

The IMT took other measures during the course of the fire to inform the public such as posting a notice describing the fire situation at roadblocks and providing a map at service stations.

Several issues concerning public information were discussed in debriefs:

It was noted that the Information Services Unit (ISU) role was undertaken by the SO along with Situation Analysis, IAP production and a variety of liaison functions. The SO was ably assisted by DEC's PCO in Perth who has considerable fire reporting experience and is well versed in AIIMs and DEC's IMS. Despite this assistance it was the view of the debriefs that the SO was doing too many functions and although the media releases worked efficiently it may have been partly at the expense of some of the SO's other roles.

The PO, ISU and PCO work together to share information that forms the content of draft media statements, but it is the IC that authorizes them and approves their release. This procedure was adopted in all cases at Boorabbin. The PCO verbally referred (read out over the phone) the first draft Media Statement (version 1830 hrs Friday 28) to the SDO. The most contentious and significant issue associated with the media statements is the apparent warning they give of the danger of the southerly wind change on Sunday evening that coincides with the planned passage of traffic on the GEH through the fire zone at 7pm. The details of the four media statements on Sunday 30 are summarised (not quoted verbatim) as follows:

Media Update 0930 hrs Sunday 30 (summarised)

The extreme weather conditions are expected to put pressure on the southern flanks of the fire but the western edges are holding and a predicted southerly wind change in the afternoon should help to contain the fire within existing breaks. The main concern for the GEH is smoke and with MRD's help traffic will be escorted past the fire zone if necessary. It may be necessary to close the GEH for some periods if smoke makes driving conditions too dangerous.

Media Update 1230 hrs Sunday 30 (summarised)

The GEH has been closed because the fire has jumped the highway under the influence of strong winds and high temperatures. Crews are trying to contain the 'hop over' so the highway can be opened as soon as possible. Motorists will be escorted through the fire in convoy if it is safe to do so. The IC said a southerly change was expected later this afternoon that would **……** (word apparently missing here) …… containment efforts. [Note: it is presumed by the Coordination Group that the word missing here is *'help'* or *'assist'*]

Media Update 1630 hrs Sunday 30 (summarised)

Fire crews continue to work on the fire that has burnt out 7500 hectares causing the GEH to be closed since mid-day. Northerly winds to 45km/h and a temperature of 43 degrees compounded the difficulty of suppression operations and brought down powerlines onto the highway. At times the fire ran at 10 km per hour but easing winds this afternoon slowed the rate of spread to around 4 km/h. The IC said a south-westerly change had been forecast for around 7 o'clock this evening. However, the change was expected to bring winds gusting to 65 km/h that could result in unpredictable fire behaviour. Police and DEC escorted vehicles in convoys through the fire area earlier this afternoon. However,

conditions are still unsafe and the highway remains closed to unescorted traffic. DEC is aiming to have the highway reopened around 7 pm. Additional DEC staff and machinery will arrive tomorrow.

Media Update 2000 hrs Sunday 30 (summarised)

The GEH is expected to be fully opened by 8 pm. Crews are continuing to work to contain the fire. The IC said that DEC had liaised with Police and the agencies had prepared a traffic management plan. *"We have opened the highway to west-bound traffic from Coolgardie and are aiming to .....* (word missing?) *east-bound traffic by around 8 pm."* The IC said torrid conditions – with a temperature of 43 degrees and winds gusting to 45 km/h – hampered suppression operations. *"It's tough fighting fires even in mild conditions"* he said. *"But today was pretty extreme and the wind, heat and smoke certainly makes things tougher.* At times the fire ran at 10 km/h but easing winds this afternoon slowed the rate of spread to around 4 km/h. The IC said a south-westerly change is due in at around 8 o'clock this evening. *"Gusting winds associated with the change could cause the fire to continue to run for the next few hours,"* he said. *"So motorists should take extreme care in the event they encounter smoke over the road."*

Coordination Group Review and Discussion

The series of media updates on Sunday were prepared by DEC's Principal Communications Officer in Perth using updated information to hand from the IMT. As an experienced professional journalist and communicator the PCO rendered the updates in the customary media ready form. They were then approved by the IC as per protocol and returned to the PCO for release to the news media. The media updates contain an element of warning to motorists about the fire hazard on the GEH continuing into the evening and being influenced by the predicted southerly change at about the time the convoys were planned. The warnings specifically mentioned the risk of smoke over the road and noted that gusting winds associated with the south-westerly wind change might cause unpredictable fire behaviour and it could continue to run for the next few hours. The main messages were that although the south-westerly wind change might be an improvement on the days extreme weather conditions there was still a prospect of fire activity producing smoke on the highway and therefore escorted convoys of traffic were necessary and motorists passing through the fire zone needed to be extremely cautious.

The *'unpredictable fire behaviour'* was a reason for caution but it was expected by the IMT that escorted convoys could be conducted safely, as they had been during the day in extreme weather conditions. A further comment in the 1630 hrs update that *"Police and DEC escorted vehicles in convoys through the fire area earlier this afternoon. However, conditions are still unsafe and the highway remains closed to unescorted traffic. DEC is aiming to have the highway reopened around 7pm."* The Coordination Group believes that the description *"unsafe"* refers to the combination of night time conditions with the possibility of smoke on the highway and some residual fire activity alongside the highway. These *"unsafe"* conditions were to be remedied by escorted convoys. The mention of the specific time for escorted convoys was a reflection of the planning

required to put arrangements in place and to allow for the traffic convoys to flow alternatively in each direction. The timing of convoys was not conditional upon the advent of the wind change from northerly to southerly as the south-west wind change was not seen by the IMT as being a critical threat.

The role of the PCO in this context needs explanation. The PCO has much experience in reporting fires but his function does not include formal fire behaviour knowledge or fire behaviour prediction and in drafting somewhat cautionary advice in the updates he did not intend to quantify or qualify the nature of the fire risk other than the possibility of smoke on the highway and a need for motorists to be cautious. From his practical experience in reporting fires he thought that a gusty wind change might cause some fire response but did not see that prospect as inconsistent with the IMT's intentions to allow controlled traffic movement through the fire zone as had been done during the day. The description of potential fire behaviour as *'unpredictable'* by the PCO in the 1630 hrs Fire Update approved by the IC, was not intended to signal a major degree of fire instability or threat that would prohibit highway traffic convoys through the fire zone.The coincidence of the two events; the south west wind change and the convoys, was a contingency that was thought to be covered by the sentries and convoy system. This view is supported by the other theme in the updates that the south-west wind change and cooler temperatures would be beneficial. The following Fire Update at 2000 hrs confirms the view of the IC that it would be safe to proceed with convoys as planned. The comment in this Update that *"Gusting winds associated with the south-westerly change could cause the fire to continue to run for the next few hours – so motorists should take extreme care in the even they encounter smoke over the road"* was a reference to conditions that motorists might expect during an approved convoy, but could be safely negotiated through exercising due caution.

As has been said elsewhere in the PIA, the IMT was not working to a particular window of opportunity for road convoys in relation to the southerly wind change wherein the exact timing and prediction of the wind change would be critical. The IMT, particularly the IC and PCO, were reporting the expected road conditions in the belief that the system they proposed would work, assisted by the caution they were requesting from motorists. It is apparent that the IC in approving the draft media updates prepared by the PCO did so with the expectation that the warnings were simply prudent in the context of escorted convoys and did not portray any degree of unacceptable risk. In debriefs the IC noted a discrepancy in two of the media releases, in that the 1630 hrs update said the IC expected the south west wind change at 7pm and the 2000 hrs update said the IC expected the south west wind change at 8pm. In fact he was expecting it at 9 pm (2100 hrs) as indicated in the Forecast Conditions in the spot forecast. The IC gave the explanation that the pressure of work probably caused him to overlook this discrepancy when he approved the draft updates.

The Coordination Group believes the IMT took appropriate measures to inform the public about the fire situation and status of the GEH on Sunday 30. Their effort was commendable considering there was no dedicated Information Services Unit staff and the task was shared by IMT members, notably the SO. They issued four media updates on

Sunday 30 December 2007. It should also be noted that the ISU processes is not a substitute for operational information flows outwards from the IMT to DEC or other agencies. Every effort must be made to make media updates and other forms of public information accurate, timely and useful, especially where matters of public safety are concerned. However, public information outputs are only one element of the complex transactions that are undertaken at large fires and to assess their validity, particularly in retrospect, they should be viewed in the total context of the IMT's intentions and management of the fire.

Recommended Actions

1. DEC will amend AIIMS documents and conduct appropriate training and awareness sessions to achieve the following:

2. The SDO will place a high priority on the early provision of an ISU to Level 2 or Level 3 fires that are likely to have significant impact on the public, public interest, other diverse stakeholders or high value assets.

3. Subject to the SDO's discretion, an ISU will accompany the dispatch of a partial PFT to a Level 2 fire, and a PFT dispatched to a Level 3 fire will include an ISU.

4. ICs and POs will avoid allocating primary ISU duties to SOs if possible.

5. Media releases will be approved and signed by the IC and issued through the PCO. The SDO will monitor the IMT's media releases to ensure they are technically correct and are adequately covering the identified risks.

6. ISUs in IMTs will provide liaison between the DEC Media Officer (MO) and the IC to facilitate efficient contact and exchange of information.

7. ICs, SDOs, and MOs need to be especially attentive to public information that deals with risk assessment and public safety to ensure that the communiqués are clear and impart the correct information and message. The IC must ensure that risk assessments done by the IMT are presented and explained to the SDO and MO prior to the preparation of information bulletins so they can be correctly rendered as public statements.

8. DEC will highlight, as specified in DEC's Guide to Media Relations Information Services for Incidents, that the MO will ensure that copies of Fire Updates are emailed/faxed through to FESA and Police Operations and all other combat and support agencies involved, as necessary.

9. The IMT and the PCO will ensure that all DEC information on an incident is coordinated.

3.14 Qualifications of Staff

3.14.1 Staff Qualifications and Experience

Debrief Issues

There was general acceptance in debriefs that the team the SDO selected to lead the Boorabbin IMT was well qualified and suited to the task as assessed on Friday 28 and for its prospects on Saturday 29. When the fire escalated on Sunday 30 with the attendant problems of growing disruption of infrastructure and GEH traffic, it was the SDO's judgment that additional staff and a Level 3 IC were needed.

The three incoming IMT Section leaders (Logistics, Planning, Operations) were all experienced fire managers and all qualified for Level 2 incidents. All had some experience of GFR conditions and in some cases considerable experience of fires in that environment. The Planning Officer had until recently been a Regional Leader stationed in the GFR for five years, the Logistics Officer was recently the Acting Regional Manager and Regional Leader Nature Conservation in the GFR and the Operations Officer is the Merredin District Manager. The Logistics Officer is qualified at Level 3 for that role and is a very experienced fire officer in all roles. The IC has 23 years service in DEC and its predecessors that involved considerable operational experience with prescribed burning and wildfires. His experience mostly relates to the Operations role in IMS. He has been in the GFR for seven years, is currently the Regional Leader for Parks and Visitor Services and is familiar with the GFR fire operations, WTA-FPP for the Boorabbin area and is a fire duty officer. The very experienced and capable Level 3 IC of the Blue PFT would have been dispatched with the initial IMT on Saturday, except that he was ill and therefore unavailable.

Coordination Group Review and Discussion

DEC's fire management staff acquire qualifications and competency through three means: formal and informal training, experience on the job, mentoring and guidance on and off the fire task. All members of the IMT had experienced the three forms of professional development to varying degrees. The individual qualifications and experience of the IMT members is documented in detail in their formal Witness Statements for the Coroner.

Most of the formal DEC fire training courses are nationally accredited and delivered by experienced trainers. DEC's FMS Training Section is a Registered Training Organisation. Staff only gain a qualification on satisfactory completion of the course. It is a maxim of DEC's fire training ethos that the formal courses do not turn out fully competent fire fighters and fire leaders, they only equip the candidates with the requisite technical knowledge. Competency is only gained by sufficient field practice at prescribed burns and wildfires with oversight by competent officers more experienced in the practice of fire management. The qualifications of fire management staff is recorded in training records and in the ready operational form of the 'Red Card' database.

The determination of an officer's current personal qualifications is done seasonally by senior District staff with the oversight of the Regional Fire Coordinator who together, and preferably in consultation with the officer being assessed, decide the level of competency attained to be recorded on the personal Red Card. The system therefore relies on a combination of formal training and experience gauged by the officer's senior management at a local level who are in a position to know what the officer has been doing in fire work and how they have performed.

Whilst the system is formally documented at several points, it is very dependent on the judgment of senior management and fire specialists at the local district and regional level. Officers are encouraged to seek opportunities to develop their fire knowledge and skills in practice and to understudy more experienced officers. Fire qualifications and skills are not directly related to an officer's rank or remuneration but may affect their career path and the roles they assume.

All of the Boorabbin IMT officers are approximately at a mid career stage of development and professional maturity, have been with the Department for many years and hold responsible management and specialist positions in Districts. They are all at least Level 2 formally qualified with substantial amounts of fire experience in south west Regions and all have some or much experience of the GFR or the adjoining Wheatbelt Region. They are therefore eminently suited to a GFR fire like the Boorabbin fire at its outset.

The Level 3 IC of Blue PFT on duty at the time became ill and could not attend the fire so the local most experienced officer, who was the RDO and acting IC, was appointed as the IC. Other IMT staff arriving on Saturday adopted their usual roles in the PFT and confirmed the local RDO as the IC. The SDO was very particular in recognizing the qualifications of the IMT and GFR experience when drawing them from the Blue PFT. There is no ranking between PFTs; they contain an even spread of the very best fire management and IMS competency and experience DEC employs. They are usually led by a Level 3 IC with Level 2 and Level 3 officers spread throughout the rest of the team leadership. As discussed in Section 3.6.5 there is no formal dispatch formula for sending PFTs to particular fires or guidelines for sending parts of PFTs to fires of any particular type or declared Level. In practice there is a customary association of Level 3 fires attracting Level 3 IMT leadership and Level 2 fires being matched to Level 2 IMT leadership, but there are many exceptions that result from tailor-made solutions for individual fires. As mentioned a number of times in this PIA all fires exhibit unique characteristics and may need 'hand picked' solutions.

In debriefs all IMT members felt they were qualified for the task at Boorabbin, and although admitting to feeling the pressure of the work loads, difficult conditions in the field and pressure from travellers at roadblocks, they were not uncomfortable with their responsibilities or how they were being acquitted. The PO made the observation that he had not been formally endorsed as a Level 2 PO, but senior District staff and PFT leader felt he was qualified and were quite happy to have him operate at that level in the context

of a PFT where there is mutual help and senior officer oversight from within the PFT and from the State Duty Officer. Calls for additional support on Friday 28 and Saturday 29 were about the quantum of work and the need to fill particular functions rather than any questions about qualifications. The decision on Sunday 30 to upgrade the IMT, did include a scaling up to a Level 3 IC in recognition of the growing complexity and consequences with the fire to the south of the GEH.

There is the question of whether the indisposed Level 3 Blue FPT IC should have been replaced on Saturday 29 by another Level 3 IC either as a matter of routine replacement or in recognition of the potential of the incident. There is no standing guideline for this situation, but the Coordination Group's expectation is that the replacement IC would simply have to be judged capable of leading the team in the particular circumstances of the incident. In fact that is what happened as a local experienced Level 2 IC was appointed to lead what was seen as a Level 2 incident. It is commonplace for Level 2 ICs to lead IMTs during Level 2 incidents, particularly in their local patch. The fact that the Boorabbin IMT was drawn from a PFT does not dictate the necessity for a Level 3 IC.

Notwithstanding the norm in DEC of PFTs being led by Level 3 ICs, is not uncommon for escalating incidents to have escalating IMTs both in terms of numbers of staff and the qualification levels in key roles. The reasons include an inability to always accurately predict the potential outcome of a fire, the actual availability of additional staff, the deliberate reservation of staff in the face of high fire hazard elsewhere or the prioritization of multiple running fires.

It should be noted, that the essential difference between a Level 2 and Level 3 IC in DEC is one of fire experience and incident management skills. Both Levels of IC are required to know the technical background to AIIMS and all of the systems, guidelines, FOGs and SOPs and the capability of fire fighters and resources. They should also have the same technical knowledge about fire behaviour. So the key difference is one of 'seniority' developed from experience that has afforded the Level 3 officer the chance to make decisions and lead teams in a wide variety of different circumstances where the adaptive interpretation of the SOPs is as important as an understanding of their technical content. As wildfire incidents are as much about managing people and resources as they are about putting the fire out, the seniority ranking in ICs and other IMT positions is somewhat analogous to the conventional wisdoms about seniority in executive management. Leadership is the essence of the IC's job, and skilled management of the team is how the IC gets the IAP objectives achieved.

The greater experience and management skills of Level 3 ICs are often important in the areas of risk assessment and large scale organization involving other authorities and agencies. The scope of their experience often gives Level 3 IC's excellent strategic risk appreciation and a readiness to call in and organize other agencies, extra combat forces and supporting agencies through an OAMG and other mechanisms. They also have a sound grasp of the need for information flows within the IMT and IMS and service the public's requirement for information. Level 3 ICs are quick to assess their resource needs in the short and longer term and are assertive in requesting those resources. Level 3 ICs

also have a prompt appreciation of fire potential that is based on technical assessments but also on experienced judgment.

Not withstanding the evident qualities of a level 3 IC, the Coordination Group accepts that the RDO/IC and the SDO made a conventional and well justified decision to replace the absent Level 3 IC with a local, experienced Level 2 IC in the opening circumstances of the assumed Level 2 Boorabbin fire. The decision also needs to be viewed against the traditional background of DEC's GFR fire experience and responses.

The other question is why the potential of the fire to become a Level 3 fire requiring a Level 3 IC was not foreseen and did not determine the decision. The explanations are given in other sections of the PIA, but to reiterate in brief, there are a number of interacting reasons, but the primary one is the immediate and pressing demands on the IMT that resulted in relatively short planning horizons focusing on managing the fire a day at a time with the formal planning targets being the production of an IAP for the next shift. Each shift had its fire suppression objectives and strategies that held some promise of success and so the prospect of a long term campaign fire with significant extended duration and impacts was not immediately evident to the IMT or the SDO. The fire was seen to be a conventional GFR type of fire based on the limited experience DEC has of active intervention in such fires. Had the prospect of a longer term fire with ongoing serious disruption of the GEH been envisaged, it would have been conventional for the SDO to send a full PFT with a Level 3 replacement IC at the outset.

Recommended Actions

1. There will be a presumption that fires with the potential to become Level 3 will require a Level 3 IC.

2. PFTs will be led by Level 3 ICs.

3. Level 3 fires will be led by level 3 ICs.

4. SDOs will pay heed to the lead times for upgrading resource commitments in remote regions considering the potential of the fire to escalate.

5. DEC will review its formal classification of the training, experience and qualifications of Level 1, Level 2 and Level 3 ICs and do the same for the other key leaders of IMTs (OO, PO, LO). The parameters describing the levels will be documented.

6. DEC will continue to develop and deliver appropriate formal nationally accredited training courses for the key IMT leadership roles.

7. The 'red card' system of practical fire competency will be reviewed and improved if necessary.

8. DEC will put particular effort into the development of fire competency and the progression of staff though the formal levels of competency using formal training, informal training, mentoring and experience on the job. DEC will have a view to successional planning and the long lead times to develop higher level fire management staff.

9. DEC will strongly support the staff involved in the Boorabbin fire to continue to develop their fire management skills and ongoing contribution to fire management and incident management operations.

3.15 Safety

3.15.1 Safety Considerations at the Fire

Debrief Issues

It was evident from the IAP, the statements of staff and from comments in debriefs that the safety of people at the incident was at the forefront of planning and operations by the IMT.

Crew leaders and members remarked that they received excellent briefings from the IMT at Kalgoorlie and particularly from the OO at the OP. Planning for operations included recognition of hazards such as traffic on the highway, power lines, severe weather conditions, extreme fire behaviour, communications, and tyre staking.

Safety strategies included those in the IAP, the preplanning of escape routes and safe zones, the fire direct flank attack suppression strategy, not fighting the fire at night, roadblocks, public information announcements, the use of aerial surveillance, and the shifting of the OP. Fire fighters safety training was demonstrated with their recognition of the 'dead man zone' in several instances. The management of fatigue was another safety measure. A critical safety decision was made by the OO and crew leaders when the fire escaped from its containment lines on Sunday 30 about 1000 hrs and the fire crews retreated to pre-determined safe areas. A further critical decision not to immediately pursue the fire south of the GEH was also prudent.

The initial strategy for roadblocks that simply prevented the passage of vehicles through the fire zone was a 'total' solution to risk management. The move to a 'partial' roadblock system was only adopted when it was apparent from the helicopter that the fire threat to the highway was seen to be low and fire behaviour could be effectively monitored from the aircraft. The escorting of convoys was also considered to be an important safety measure to ensure an orderly progression and to give comfort to drivers from the presence of police vehicles and fire tankers.

The IAP effectively covered hazards, safety warnings and safety strategies, that included the GEH (e.g. roadblocks), but did not produce a traffic management plan as such. The

AIIMS system makes provision for a 'traffic plan' in Section ICS 3.4 of the IAP that focuses on the safe and efficient movement of fire fighting vehicles. As previously discussed, the IMT felt they were focusing on the safety aspects of the GEH for both fire fighters and the traveling public, but acknowledge they did not compose those considerations into a formal documented 'traffic plan'. A formal traffic plan could also have been a strategically effective means of integrating the relevant road management agencies into the joint process of managing the GEH. It should be noted that given the traditional limited scope of an IAP traffic plan, it would have been very unusual and innovative for the IMT to create one that covered all vehicles affected by the fire, especially considering that DEC expects the road management authorities to take responsibility for the management of traffic on public roads in such circumstances.

AIIMS provides for the role of 'Safety Officer' and this function was filled. The Safety Officer function is not intended to supplant the need for all leaders to 'think safety', but can play a special role in taking an objective overview of how all aspects of safe practice are managed during an incident and advises the IC accordingly.

Coordination Group Review and Discussion

It is clearly evident to the Coordination Group that the IMT gave the subject of safety the highest priority. Their concerns and efforts are well documented in the IAP and were followed through on the fire ground. There was resounding acknowledgement of the IMT's safety measures in the debriefs from all quarters and most meaningfully from the fire crews who noted the thorough briefings at the ICC and OP. The OO was able to give a detailed account of his briefings that demonstrably covered the hazards and risks highlighted in the IAP and also those known to him directly at the incident.

The IMT showed excellent anticipation of risks and hazards and made good use of the WTA-FPP and the local knowledge of GFR officers. It is particularly pleasing that DEC staff were responsive to the safety messages and measures and that their extensive prior training and experience of fire line safety came to the fore. The recognition of "dead man zones" and the designation and use of safety zones and escape routes were examples. Correct judgment of risks associated with observed fire behaviour translated into safe tactics and the anticipation of dangerous fire behaviour was evident in the fire suppression strategies adopted in the IAP. The Coordination Group believes the IMT can be credited with an excellent safety performance in looking after fire suppression personnel. The experience and skill of DEC crew leaders and the fire crews themselves was also instrumental in ensuring the IMT's safety measures were applied in the face of extreme fire behaviour.

The IMT was equally concerned about the safety of traffic on the GEH from the start of the fire and took conventional measures in keeping with DEC's IMS and FPI 75. The details of these measures and the thinking of the IMT are also covered under the Traffic Management Section of the PIA.

The key question is why did DEC's very strong safety culture, so effectively applied to DEC fire fighters at Boorabbin, not have a similar safe outcome for the occupants of some vehicles on the GEH?

The answer is that there were two critical deficiences in the safety delivery system for the GEH.

The first of these was the risk assessment system for predicting the danger to the GEH from the fire on Sunday evening. This has been discussed in detail in other sections of the PIA and will not be repeated in detail here. The responsibility and the technical 'system' for doing this is entirely DEC's as the HMA and DEC must look within to find the remedies. Solutions will include the adaption of fire prediction tables, changes in the focus and timeframes for fire prediction in IMTs, progressive use of GIS technologies as fires develop, improved fire level declaration guidelines, more disciplined use of forecasts, greater sensitivity to unusual weather forecast conditions, greater situational awareness about drought factors and extreme weather conditions, more precautionary dispatch of PFTs, continued development of IMT experience in remote regions and improved experience based 'models' of fire behaviour in remote regions. Formal and informal training of staff will be applied to achieve the delivery of these improvements.

The second reason was the inadequacy of the 'system' for managing roadblocks and associated traffic safety and welfare matters. This is initially a joint responsibility between DEC and the road traffic authorities with the latter taking over full responsibility at the earliest possible time after DEC declares there to be a fire risk to the road users. This has also been covered in detail in other sections of the PIA and will not be repeated here. The remedies for this system deficiency must come from the development of joint guidelines for vehicle control point management matched with complementary SOPs developed by relevant agencies so they can exercise their respective responsibilities and authority in the context of the VCP Guidelines.

The Coordination Group concluded that DEC's IMT made strenuous efforts to both protect travelers on the GEH and to facilitate their onward journey for the New Year long weekend commensurate with what they considered to be their current SOPs. Local police at roadblocks supported the IMT to the best of their capacity. The lack of a common detailed guideline for roadblocks, and the late call for the interagency mechanism of an OAMG, meant they struggled to adequately cope with the magnitude of the problems at the roadblocks. In effect, the IMT and police improvised and made good use of the resources they had, particularly the helicopter and experienced Air Observer, which worked well in the daytime but was not effectively converted to an adequate night time procedure.

The Coordination Group's review of the debriefs and the information (limited to DEC sources) available to it has shown that there was a high level of safety consciousness in the IMT and amongst local police at the roadblocks and the strategies they adopted were consistent with their safety objectives, desire to assist stranded travelers and situational awareness.

Recommended Actions

1. The role of the Safety Officer in the IMT and IMS should be inclusive of all of the safety responsibilities that pertain to the HMA (DEC). It should be a strategic level overview as well as a tactical SOP level. It will include responsibilities detailed in FOG 75.

2. FOG 75 will be improved to include the lessons learned from the Boorabbin incident and will be integrated with the interagency VCP Guidelines.

3. ICS Section 3.4 Divisional and Sector Transport Plan in IAPs should be broadened to incorporate the provisions of FOG 75 so it fully integrates with the interagency VCP Guidelines.

4. Major roads within fire grounds should be considered for designation as a 'Traffic Management Division' with specific Divisional planning included in the IAP. The Road Traffic Management Division will need to fully integrate with FOG 75 and the VCP Guidelines that allocates responsibilities and sets out functions.

5. The safety SOPs so effectively applied to DEC staff at Boorabbin will continue to be supported with all of DEC's training, briefing and AAR/PIA processes to reinforce their continued use.

6. Fire fighting strategies and tactics for shrublands and mallee heaths and remote area fires will highlight the special safety features that apply to fires in these areas with these fuels.

7. Communications systems will be improved and be mobile to cover all communications needs in remote area incidents.

8. A cache of truck tyres will be forwarded to remote area fires where there is a risk of excessive tyre staking.

9. SAR for aircraft in remote areas will meet normal DEC and CASA standards.

3.15.2 The Management of Fatigue

Debrief Issues

The IMT was fully aware of the need for fatigue management as the risk of fatigue was exacerbated by the very arduous conditions prevailing at the fire.

The single shift situation with no overnight operations simplified shift arrangements and the usual challenge of overlapping shift changes. Distances and travel times between the

fire and accommodation centres were the main influence on fatigue management schedules. There was a necessary reduction of time on the fire to meet minimum rest periods for fire crews and IMT staff. This was well managed and most staff had their minimum rest breaks. There were some exceptions, particularly amongst IMT leaders. However in debriefs all key staff commented that they were fit for duty during the first four shifts including the critical period on Sunday 30 leading up to the fatalities.

It was noted that distance and travel times must be recognized as a special constraint in remote area fire fighting, such as the GFR. It affects initial attack response times, the supply of resources, the reinforcing of resources, the supply of equipment and materials, and fatigue management. The use of aircraft to deliver staff to the fire assists by reducing travel time and travel fatigue.

The debriefs discussed the pros and cons of various options for accommodating staff working at the Boorabbin fire and it was the view of the IMT that they had used all available options that provided reasonable rest for staff. They had utilized the on site accommodation at Koorarawalyee for key people needed at the OP or fire line and had invested the necessary time in shifting most staff to suitable quality accommodation in Kalgoorlie. They felt that, even in retrospect it had been the correct decision.

However, it does raise the question of DEC investigating ways to accommodate more staff at or near the Operations Point to reduce the problem of travel times. It was recognized that forward basing of staff is a difficult logistical challenge and also raises uncertainties about the quality of rest that might be provided to crews.

Coordination Group Review and Discussion

The Coordination Group was interested to know whether IMT staff or any other leaders at the fire were fatigued and if so did they feel it might have affected their judgement or the decisions they made?

It is evident from the record of the time IMT leaders spent on duty during the first three shifts that most of them lost some of their normal sleep pattern and would have experienced some tiredness. However, none of them felt that fatigue had adversely affected the performance of their duties or the outcomes of their work. The Coordination Group accepts their opinion as there is no evidence to the contrary and the regime they worked was not exceptional for the start of an incident when shift schedules are settling down. They had been called to the task on Friday afternoon and traveled the next day by aircraft in the case of the PO and LO, whilst the OO drove himself from Merredin with an early start on Saturday. The IC was already based at the ICC at Kalgoorlie.

This is not an unusual regime for an IMT. Experienced IMT staff and Duty Officers are accustomed to fires being particularly demanding mentally and physically. DEC requires IMTs to manage the fatigue of everyone at the fire by monitoring their hours of duty and ensuring they obtain a minimum of eight hours of sleep based on a ten hour rest break. Supervisors endeavour to achieve a work to rest ratio of 2:1 so in any 24 hour period

work will be less than 16 hours and rest will be at least 8 hours. The first shift should not exceed 24 hours and each subsequent shift should not exceed 16 hours. On completion of five consecutive day shifts or three nights in which extended hours are worked, a minimum of a 24 hour rest break is mandatory. As a further precaution, staff coming off the incident are chauffeured to their accommodation to avoid road traffic risk, especially if they have worked more than 16 hours.

DEC has a system of making sure staff attending fires are fit to do so with preseason medical checkups and a physical test in the form of a timed walk carrying a loaded backpack.

All staff know they have a duty of care to themselves and their work mates, to obtain sufficient rest, be fit for duty and to declare themselves unfit should they become so. The Department makes it very clear that staff making any self declaration of being unfit for their task or for duty will be respected and in fact congratulated for their action. The LO makes every effort to ensure that accommodation meets standards that provide adequate rest, food and comfort. Drinking of alcohol whilst on duty is banned and moderation through self regulation encouraged during rest breaks. DEC has no means of regulating the taking of drugs, prescription or other kinds, and relies on the integrity and self discipline of its staff.

All staff understand that should they notice any impairment of a fellow worker's capacity or performance at an incident they should take measures to remedy the matter. DEC fire fighters appreciate they are interdependent in potentially life threatening situations and have a well developed sense of mutual responsibility.

The single shift regime at Boorabbin with no overnight shift helped to simplify the management of fatigue. One of the customary 'pinch points' in managing fatigue occurs at the handover of day-night shift changes when large numbers of people and vehicles are being coordinated and delays can occur in that organizational process or the fire condition interferes with plans.

The Coordination Group has come to the conclusion that although conditions at the fire were exceptionally enervating and staff were under great mental and physical pressure, particularly the OO and his staff at the OP, and they acknowledge some tiredness; fatigue did not affect the performance of their duties or influence the outcome of the fire.

The IMT managed the fire in compliance with DEC's FOG 12 Guidelines for Fatigue Management in Emergency Situations. The Boorabbin fire demonstrated the special constraints that apply to remote region fatigue management, but did not produce any recommendations for changes to FOG 12.

Recommendations

1. Duty Officers will recognize the special constraints of time and distance in remote region incidents that can affect fatigue experienced by fire fighters and the special difficulties of managing that fatigue.

2. The special constraints in remote region incidents affecting logistics will be taught in formal LO training courses.

3. IPRPs will preplan accommodation for fire crews, IMTs and PFTs.

4. DEC will investigate strategies for forward basing more staff in closer proximity to the OP.

5. DECs fatigue management system at fires will continue to be rigorously applied.

6. Improved technology systems for tracking the duty time of staff will be developed for more efficient fatigue management.

7. Fly-in, fly-out systems (aircraft), or like-for-like resource replacement or rotation by road vehicle will be investigated where established accommodation is inadequate and opportunities for forward basing of staff is limited.

3.16 Training

3.16.1 Staff Training Before and After the Fire

Debrief Issues

The debriefs did not specifically identify any DEC fire training deficiencies that became evident during the incident or were thought to contribute to any adverse outcomes. Nevertheless, training was seen as one of the prime means of making improvements particularly relating to remote area operations.

Improvements could be achieved from appropriate training in the following:

- IT and communication specialists training to cover communication infrastructure limitations and solutions for remote area operations

- Logistics training that improves awareness of time and distance for transport and logistical constrains in remote regions

- Better interpretation of fire behaviour models for fire prediction in shrubland and mallee heath fuels

- Better procedures for risk assessment in relation to road management

- Training to achieve a detailed understanding of roles and prescriptions for vehicle control point operations

- Training of DOs and IMTs in the development of the IAP initial incident appreciation process that produces timely strategic fire assessments and potential fire level classifications

- Training to achieve a greater procedural discipline and sophistication in interpreting weather forecasts

- Training and informing IMT staff in the role and callout procedure for OAMGs and IMGs.

- Training in how the new DEC State Incident Coordination Centre (once approved) will operate particularly in relation to strategic incident assessment and monitoring.

The debriefs had more to say about what went right with DEC's fire training in that much of the operation conformed with accepted standards that reflected well on the training of staff and their application of that training in the heat of battling a large fire. Perhaps the most noteworthy was the evident safety awareness from the IMT down to the crews on the fire tankers, where it mattered most. A fast moving fire like this in an area with little high quality access poses a considerable risk to fire crews. Their training was to the fore when the fire presented acute risks. Their background training in safe operating procedures assisted police with the management of the roadblocks and convoy system.

Many other aspects of the work of the IMT and crews at the Boorabbin fire were well regarded by their peers in debriefs and thought to reflect positively on the application of their training. (This comment comes as part of an objective PIA critique that recognizes the positive performances as well as those that need improvement and is mindful and respectful of the tragic outcome of the incident.)

Coordination Group Review and Discussion

DEC has a comprehensive fire training program, both formal and informal. The formal courses being professionally developed, nationally accredited and quantitatively assessed units and the informal being achieved largely by experience at wildfire incidents and through mentoring. Officers become qualified for IMT roles by progressing through both forms of training and are matched to the level of fire complexity. A 'Red Card' system records their qualifications and comprises both the theoretical and practical elements of training, with senior District and Regional management and fire specialist staff assessing officers progress and competency status. The Coordination Group is aware that DEC's

fire training program is recognized amongst fire training practitioners in Australia as advanced and competent.

It is relevant to the PIA to ask if the two main issues at the Boorabbin fire, the prediction of fire behaviour on Sunday evening and the management of roadblocks, were in any way influenced by the training DEC staff had or had not received.

With respect to fire prediction and risk assessment the IMT had sufficient formal training to do all of the leadership roles in the IMT at a Level 2 fire but did not have a great deal of experience of large Level 3 fire suppression operations in the GFR environment. (Other sections of the PIA also deal with this, particularly Qualifications.) Some aspects of theory were not covered in their training, particularly fire prediction in GFR shrubland fuels in drought conditions, and this gap was not compensated for by sufficient practical experience of large fire suppression operations in extreme weather conditions in the GFR. The IMT's extensive fire training and experience in forest fires equipped them well for most tasks in managing the Boorabbin fire during daytime conditions, even during the ten hours of 'extreme' fire danger index on Sunday 30, but was not adequate for predicting the effect of the south west wind change overnight. The very high fire danger that was still conducive to 'blow-up' conditions with the wind change was not fully appreciated.

At one end of the training spectrum this is a technical issue of absorbing and interpreting fire behaviour tables and weather forecasts, and at the other experiential end of the spectrum it is about setting risk boundaries. Both the theoretical and practical elements of DEC's fire training on these specific subjects and relevant in these special circumstances in the GFR were limited, and in the event proved insufficient.

The Coordination Group believes that what has essentially happened here is that the very effective DEC fire fighting capability is being progressively applied to remote regions, with the GFR being the most recent, needs to address some specific technical requirements that have not yet been captured by the training system. The Coordination Group suggests that the gap between training and practice is actually quite small both in terms of the development and the quantum of subjects, but the misfortune of Boorabbin is that the technical demands for fire prediction in extreme conditions happened to coincide with a major road traffic management challenge.

Risk assessment combines the technical aspects of fire prediction with the setting of risk boundaries that are based partly on judgment borne of experience. It is difficult to impart the latter in training courses but DEC helps its senior fire managers gain this knowledge with a fire leadership course. An IC training course is also in development. Training courses for the other IMT leadership roles of Operations, Logistics and Planning are well established in DEC.

Particular mention must be made of training in relation to using weather forecasts. Fire meteorology and weather forecasts are a key part of DEC's Planning Officers course. It is axiomatic that the weather is one of the two main influences on a fire (fuel being the other) and all experienced DEC fire managers are intimately familiar with dealing with

weather parameters on a daily basis during the fire season. The daily district forecasts are available to staff via DEC's computer network and are discussed twice a day during the prescribed burning season and as often as necessary during a wildfire. So forecasts are very familiar daily fare for DEC fire managers and are regarded as highly important intelligence. It would therefore seem inexplicable that key members of the IMT in debriefs were not able to recall reading the Significant Wind Change and Weather/Remarks text boxes in the spot forecast of 5:09 pm on Sunday 30. One would expect from their experience and training that IMT members would always read the entire forecast and also make sure it was fully absorbed by those that need to know what it contains (Note: the OO did not receive this spot forecast until Sunday evening) In the absence of any other explanation, the Coordination Group believes that this oversight was ironically a result of the officers familiarity with forecasts and in this case they believed they had read the main parameters in the Forecast Conditions text box that was simply confirming what they knew about the pattern they had been monitoring for two days. The Forecast Conditions text box in fact does contain the main message and does show the south west wind change, but at a coarser level of detail, particularly in relation to timing, than the information in the box below it. As they were not giving the overnight south west wind change any special credence as a harbinger of increased danger they looked no further for additional information on that aspect. It may be a case of finding what you expect to see. This is obviously not an acceptable oversight given the vital importance of weather forecasts, especially when they contain wind changes. This error should be amenable to a training remedy. It will be recommended that DEC institute an even greater insistence in SOPs and training programs that IMTs implement the complete reading, interpretation, dissemination, acknowledgement, recording and discussion of each and every forecast in a fire situation.

With respect to the other main issue, the organization of roadblocks, the IMT had little specific training. In DEC's IMS training, the preparation of a Traffic Plan rests with the Ground Support Unit under the Logistics Section, but as described elsewhere in the PIA, the Traffic Plan relates to the organization of traffic in and around the incident, not public traffic on roads. The application of FPI 75 (now FOG 75) did not require training for road traffic management as the procedure it outlines hands road management to the road management authorities at the earliest possible time. For roads managed by DEC (typically on DEC managed land), a contractor will be engaged and provide properly qualified and equipped traffic controllers. The new Draft Vehicle Control Point Guideline prepared by the police, MRWA, FESA and DEC in consultation with representatives of local government will require complementary changes to FOG 75 and it is expected that an implementation training program for IMTs will be put in place. The new VCP Guideline will apply throughout the State so PFTs attending any region, including remote regions, should find the same system for road management and their training will be universally applicable. DEC's IMTs continuing central role in VCPs will be their initial declaration of the need for a VCP followed by periodic risk assessments to determine their ongoing status. The actual conduct of the VCP will remain the responsibility of the road management authorities led by the police. All agencies will have to put in place appropriate SOPs to give effect to their functions. The VCP Guideline and SEMC Policy Statements will be common to all. Each agency will need to see to their own training

tailored to their SOPs. DEC would welcome any joint training or practice exercises and will encourage Regional Managers, District Managers and Regional Fire Coordinators to make preseason contact with the other agencies who would be involved in bushfire VCPs. Contact information would be included in IPRPs and be included in preseason training of DEC staff.

In summary; the Coordination Group has come to the conclusion that the standard of training that backed the IMT and fire crews equipped them for dealing with most of the very arduous and challenging conditions encountered at Boorabbin, but did not include the novel element of adapting the mallee heath fire tables to suit GFR shrubland fuels in a drought condition, or the interpretation of extreme weather conditions in that remote region. The strategic assessment of fires, declaration of the level of fires and risk analysis of running fires will be improved by changes to DEC's IMS system and training to explain and indoctrinate staff accordingly. More training is needed to clarify when and how to call for support from other agencies through the auspices of WESTPLAN – BUSHFIRE, SEMC Policy 7, FOG 75 and the new VCP Guideline when there is a bushfire threat to road users.

The adoption of a significant number of other recommendations from this PIA, DEC's Findings and Actions report and the GHD reports will sponsor modified or new training initiatives. They are listed under the relevant section headings in this PIA.

Recommended Actions

1. Priorities for DEC's fire training program will be reviewed with reference to the recommendations emerging from the Boorabbin wildfire incident.

2. Training of IMT staff and Duty Officers in the use of the draft VCP Guideline will occur prior to the 2008/2009 fire season.

3. Preseason training in the application of the revised FOG 75 will occur prior to summer 2008/2009 and subsequent fire seasons.

4. Preseason training of IMT staff and Duty Officers will occur to explain the changes to DEC's IMS (ICS) forms and procedures, particularly the strategic assessment and projection of wildfire.

5. Training of IMT staff, particularly Planning Section Situation Unit (SU) staff in PFTs, in the adaption and use of mallee heath fire prediction tables in several relevant regions will be implemented.

6. Training as listed in recommendations for other Sections of the PIA.

3.17 Critical Incident Management and Staff Welfare

3.17.1 Critical Incident Review Process

Debrief Issues

Several debriefs commented on the adequacy of the processes that were implemented by DEC to deal with the aftermath of the fatal incident. Prior to the tragic fatalities that occurred in the Boorabbin fire, there had been no firefighter or public fatalities during wildfire incidents managed by DEC since the 1950s (excluding traffic accidents outside the fireground). It is estimated that DEC would have had lead agency status at more than 20,000 wildfires during this period. Dealing with a critical incident involving fatalities such as the Boorabbin fire was unfamiliar to DEC.

It is known that may DEC staff who were involved in the Boorabbin fire were vulnerable to the effects of Critical Incident Stress (CIS). Post Traumatic Stress Disorder (PTSD) is a more extreme reaction to a traumatic incident and is usually related to other factors that an individual brings to a critical incident. There was an immediate realization that DEC would require professional services to help deal with the range of staff welfare requirements. DEC has an Employee Assistance Program (EAP) serviced by a consultant company Occupational Services Australia (OSA) now called PPC Worldwide. DEC sent qualified OSA staff to Kalgoorlie on 1 January 2008. Critical Incident Stress Debriefing (CISD) was carried out with most IMT staff who departed the incident via Kalgoorlie. Some IMT staff and fire crews who departed from the OP to return to their work centres did not have group CISD, nor did they have one to one meetings with OSA staff. OSA staff spoke to several key staff by telephone after they had returned to their work centres.

DEC initiated an Incident Response Team (IRT) to coordinate all aspects of the aftermath of the incident. The IRT structure was based on the AIIMS structure with the Director Regional Services as Team Leader and functional leaders for People, Incident Review, Communications and Legal streams of activity (see Appendix 1). The People function incorporated both internal staff welfare and external liaison programs, especially in relation to the provision of information and support to the families of the deceased. Advice and assistance was provided by several counterpart agencies in other states, including the South Australian Country Fire Service (CFS) who had experienced an incident involving multiple fatalities in 2005 (the Eyre Peninsula fire). Advice received from CFS included a Crisis Management Checklist and the adoption of a "Lessons Learned" approach to post incident inquiries and remedial actions.

The IRT coordinated the conduct of all incident review processes, including two independent reviews, the Post Incident Analysis and the compilation of a report "Findings and Actions from Inquiries Conducted by the Department of Environment and Conservation into the Boorabbin fire – 28 December 2007 – 8 January 2008" (known internally as the "Lessons Learned" report). The IRT convened a group of experienced fire practitioners (the Lessons Learned Coordination Group (LLCG)) to analyse the information from debriefs and make recommendations for improved fire management

and incident management procedures. The depth and breadth of these post-incident reviews exceeded those that have been conducted since the Dwellingup Fire in 1961.

DEC has endeavoured to keep Departmental staff informed about the post-incident processes through regular briefings and workplace-based meetings, facts sheets, grouped emails and an intranet website. Key staff have been provided opportunities to comment on the accuracy of incident review reports.

OSA staff and DEC's managers and supervisors have continued to monitor key staff and provide appropriate support. Several workshops have been held to provide affected staff with some tools and techniques to manage their own situation.

Senior DEC staff have maintained regular contacts with the families of the deceased. Information about the findings of DEC's reviews and inquiries have been shared with family members, subject to the consent of the Coroner. Support has been provided in various forms to family members following the incident. DEC initiated the Service of Remembrance that was held at Boorabbin on the one year anniversary of the incident on 30 December 2008.

Coordination Group Review and Discussion

DEC's formal processes (policy, procedures) that deal with the management of Critical Incident Stress require updating following the Boorabbin incident and with the knowledge gained by DEC staff who worked on wildfire incidents in the USA. A generalized brochure "Back on Track" was distributed to affected staff following the incident and was subsequently distributed more widely. A Victorian publication "Working in an Emergency" was recognized as a suitable model for DEC staff (and perhaps for other Emergency Management (EM) agencies in WA). This brochure was also distributed to affected staff. The requirement for improvements to key documents was noted. DEC's Risk Management Section is the custodian for these documents. There is a requirement for Incident Controllers, IMT leaders and line managers to understand the requirements for CISD. This will ensure a more consistent and professionally based response to staff welfare needs.

It is clear from research conducted in the USA and elsewhere that there is a high likelihood that emergency services workers will suffer the effects of CIS and some will be affected by PTSD. More than one exposure to a critical incident increases the likelihood of PTSD seven fold. Personnel offering debrief facilitation and "counselling" services must be appropriatly qualified.

Valuable feedback was obtained from affected staff in regard to what CIS management actions worked well and what did not work well. The importance of prompt action; arranging time to contact families; checking on travelling home arrangements; understanding that emotional responses will continue for an extended period; and tailored responses for individuals was noted. Support from colleagues and senior staff was considered by affected staff to be important.

Recommended Actions

1. Develop a checklist for the management of emergencies and critical incidents on DEC-managed lands and waters, based on a model provided by the Country Fire Service in South Australia. The checklist will include the use of an AIIMS style incident response team to manage all aspects of the aftermath to critical incidents; guidance for liaison with people outside of DEC affected by an incident; incident review processes; and staff welfare requirements.

2. Develop improved policy (update Policy 42) and procedures for dealing with Critical Incident Stress and conduct training to ensure that ICs, IMT leaders and line managers understand the requirements. Consider drafting a FOG that will provide guidance for team leaders.

3. Issue an instruction to ensure that CIS debriefing is carried out for all staff exposed to critical incidents, preferably before they leave the incident, and if not as soon as possible after they return to their workplaces.

4. Prepare a "Working in an Emergency" booklet, based on the Victorian model, for DEC staff. Check with other Western Australian EM agencies to offer a collaborative approach.

SECTION 4

CONCLUSION AND SUMMARY

4.0 SUMMARY of PIA

4.1 PIA Process

The Department of Environment and Conservation's Fire Operational Guideline (FOG 31) sets out a procedure for conducting After Action Reviews (AAR) and Post Incident Analyses (PIA) of significant incidents. The Boorabbin PIA follows the Guideline and is tailored to the special circumstances of the incident. As an analytical process it is the link between the facts gathered from the actual events and the conclusions drawn about the outcomes from the incident.

The PIA was also guided by an instruction from the Director General of the Department of Environment and Conservation (DEC) to thoroughly investigate the Boorabbin fire incident to discover what happened, why it happened and to implement appropriate measures to guard against a recurrence of anything that DEC can control that might have influenced the tragic outcome.

The PIA was but a part of a comprehensive review of the incident conducted at a number of levels that included a thorough investigation by a qualified independent expert contracted from GHD Pty Ltd. The reviews sponsored by DEC were limited to those information sources accessible to the Department, comprising mostly DEC staff and documents. The Police Arson Squad acting on behalf of the State Coroner investigated other sources of information outside of DEC's authority. The PIA therefore presents DEC's account of the incident and makes recommendations for changes and improvements to the Department's Incident Management System (IMS). Collaboration with other agencies on common systems is also occurring.

The AAR/ PIA commenced immediately after the tragedy on 30 December 2007 and was continuous for the following year, 2008. A group of DEC staff titled the Incident Review Team (IRT) was dedicated to the comprehensive review process and evolved into the Coordination Group (CG) as the investigation phase became an action implementation process.

The early fact finding work employed group debrief sessions, individual interviews and a detailed study of documents. Witness Statements by DEC staff for the Arson Squad were also very informative.

The IRT's analysis referred to DEC's Standard Operating Procedures (SOP) documented as Fire Protection Instructions and Fire Operational Guidelines that are applied in the context of the Australian Inter-service Incident Mangement System (AIIMS) and customized into DEC's IMS (previously called Incident Control System (ICS)). Many other components of DEC's extensive operational fire procedures and practices were also considered in the analysis and the term SOP is intended to include them. The formal SOPs were used by the IRT as a benchmark to objectively assess the management of the Boorabbin incident.

The IRT also assessed the more subjective aspects of the incident that relate to the experience and judgment exercised by the Incident Management Team and crew leaders that cannot be easily quantified and compared with a SOP. The 'unwritten' components of fire leadership and management required the IRT to come to a professional judgment about the actions and decisions the IMT made. The IRT's views on subjective issues are submitted with the qualification that they come with the advantage of 'hindsight'.

The IRT identified many issues of which thirty three were considered especially significant. These were analysed in depth and produced recommendations for improvements to DEC's FOGs, IMS and supporting fire programs and training. Some require an interagency effort to achieve common guidelines and procedures. The IRT and CG also noted that the IMT and fire crews were mostly compliant with SOPs and did many things very well, reflecting their extensive experience and training as firefighters. The positive things have been noted and serve to reaffirm existing best practice, but it is the nature of investigations to particularly focus on things that need attention so lessons can be learned and improvements made. The PIA adopts this emphasis. DEC has also responded to the very thorough GHD reviews and accepts their findings. The GHD Reports and DEC's PIA were independently derived, but are in accord on all matters of fact and the major conclusions and recommendations.

The essential conclusion of the PIA is that the tragic outcome of the Boorabbin fire resulted from the unfortunate conjunction of a number of specific circumstances, some unique to the context of the Boorabbin incident and others more generic within DEC's IMS. Some relate to interagency IMS functions.

Three dominating causes of the incident outcomes have been highlighted in this summary. They are; the expectation of fire behaviour in shrubland fuels at night, the procedures for managing road blocks, and thirdly, the strategic assessment of the fire's potential.

These three causes are summarised below:

4.2 Night Time Fire Expectations

The most critical contributing factor was the unfamiliarity of the IMT with the extremes of fire behaviour that are possible in the conditions prevailing on the night of 30 December 2007 at Boorabbin. The extensive fire experience of the members of the IMT did not include fighting fires at night in those fuels and weather conditions, exacerbated by drought. Consequently, the expectation of all members of the IMT was that the 'normal' pattern of Goldfields fires dying down at night due to rising relative humidities, declining temperatures and lower wind speeds would prevail. This 'standard expectation' was reinforced by what was presumed to be 'normal' behaviour of the Boorabbin fire during the nights of Friday 28 December and Saturday 29 December. The same was expected on Sunday evening (30 December 2007) and through that night.

The technical expertise that this IMT would routinely apply to interpreting fire behaviour parameters in the south west forests was not fully transferable to Goldfields fires that are considered essentially diurnal. The simple behaviour expected of Goldfields fires is that they are dominated by the flammability of the few main fuel types and their intensity and rate of spread is determined by temperature and wind direction. The most critical factor is wind strength and direction that obviously predicts where the extensive elongated fire runs will go. Long runs or extensive areas of fire are invariably arrested by the many large areas of low or no fuels such as woodlands or salt lakes. Important constructed assets are usually not at risk.

It was mentioned at the time within the IMT that Goldfields fires might continue to run in extreme conditions, but this seems to be a somewhat abstract thought that did not displace the standard concept of daytime-only fire runs. Thus the extreme condition represented by the technical parameters in the Sunday night weather forecast was not linked to extreme fire behaviour.

The most significant decision the IMT made was to presume the diminishing fire behaviour comprehensively observed and reported as dusk fell on Sunday was confirmation of their prior expectations that the fire would be quiescent overnight and any invigoration caused by the south west change in the weather would be minor. This confidence sanctioned the overnight road traffic convoy system.

It has been publicly reported that the IMT was deliberately squeezing convoys through a narrow window created by the lull between the prevailing daytime wind from the north and the south west change overnight that would bear down on the highway and the tragedy was caused when they got the timing wrong. The fact is that notwithstanding the apparent warning of unpredictable fire behaviour in the DEC press releases and the IMT oversight of part of the forecast, they were not expecting the fire to escalate to any significant degree and therefore were not working to any compelling concept of a 'window of opportunity' that had to be precisely executed. In fact they thought it would get easier to run convoys during the night and they would only require two sentries and a small escort contingent.

DEC's review of the fire has examined the technical tools and operational experience available to the Boorabbin IMT to predict fire behaviour. The two methods of predicting fire behaviour are technical fire behaviour tables and the experience of the officers. At the Boorabbin fire both were lacking. The undoubted technical skill of the IMT in using fire behaviour prediction tools in south west forest fires was not transferable to Goldfields fires as there was no history of using such tools in Goldfields fires. Practical experience can substitute for a 'scientific' quantified methodology, but as explained, the Goldfields experience of the team was conditioned by the traditional expectation that shrubland fires usually die down at night and this is what they observed on Friday and Saturday nights. They expected the same on Sunday night and so the night time weather parameters of very low dew point, low relative humidity, continued elevated temperature and predicted strong gusting winds with the south west change remained somewhat cryptic and unrecognized as the talisman of *'blow-up'* fire conditions.

DEC's review has also recognized the fact that a fire prediction table for mallee heath fuels for the south coast area was available at the time of the Boorabbin fire but as it was developed for the south coast environment it had not been used in other mallee heath areas of the State such as the Midwest Region or the Goldfields. An examination of the table by DEC fire research staff shows that although there are some differences between the south coast area and the Goldfields, the table can be used to give reasonably accurate fire behaviour predictions for Goldfields shrubland fires. Putting the weather parameters of 30 December 2007 near Boorabbin into the table produces a prediction of extreme fire behaviour with rates of spread in excess of 2500 m/h. The prediction is independent of the time of day or night and therefore would dispel traditional concepts of low night time fire behaviour in extreme conditions in these fuel types.

DEC has looked at why the south coast mallee heath fire prediction table has not become standard operating procedure in the Goldfields Region. The primary reason is that the fire management program in DEC's Goldfields Region is in a development phase from historically only monitoring large fires in remote areas to a new era of an active fire planning and operational program. The well developed fire suppression organization traditionally centered on the south west forests is increasingly being deployed to the outlying regions. The Boorabbin fire response is an example and was the largest of its kind to date. The Wildfire Threat Analysis and Fire Prevention Plan for the Boorabbin area is another example and even captures some elements of the south coast mallee heath fire prediction tables, but the full use of the table had yet to become standard operating procedure. The evolving process of improving DEC's fire suppression capacity in the Goldfields was one of the unique conjunctions that contributed to the outcome at the Boorabbin fire.

4.3 Road Blocks

The IMT did not have an interagency standard operating procedure for managing roadblocks, and the DEC guideline was not comprehensive. In the absence of a well defined guideline the IMT and supporting agencies improvised a system that moved from an open highway on Friday and Saturday to a complete blockage of traffic initially on Sunday 30 to a partial road block on Sunday afternoon and evening that allowed escorted convoys through when considered safe to do so. In retrospect DEC believes this was a reasonable decision considering the fire situation, the severe conditions endured by travelers at road blocks and the strategic importance of the Great Eastern Highway (GEH). Although the road blocks and later convoys worked, they were not without their problems that mostly resulted from the limited resources and unfamiliar operational procedures needed. Both of these problems would have been relieved by the IMT requesting more support from outside the region, preferably by invoking the established mechanism of an Operational Area Management Group that would coordinate outside and interagency support. The IMT did not do so probably because of the reasonable prospect on Saturday that they might prevail in stopping the fire north of the highway, the rapid pace of development of the incident on Sunday and unfamiliarity with the process of calling an OAMG. The formation of the OAMG is usually triggered by the SDO or

Level 3 ICs in very large fires and may have been outside of the experience of the L2 IC. As the SDO was not aware of the rapidly evolving road block innovations he did not trigger the OAMG in his own right until the next day.

The critical question DEC has examined is what influence did the road block system have on the tragic outcome?

It may be possible that had there been more resources at the roadblocks on Sunday evening then the eastern road block would not have been left unattended and there would have been more capacity to escort convoys and block the road when the fire escalated. It may also be possible that extra resources such as police, DEC, FESA and MRWA contractor units at the road blocks might have prevented drivers entering the danger area and could assist them in making a safe withdrawal from the fire zone. Extra resources would themselves have been in trouble at the eastern road block if they did not realize that the fire was approaching on a wide oblique front with extreme fire behaviour. The absence of the Air Observer at night to give a warning was a critical factor.

Notwithstanding the significance of resources and operational procedures available at the road blocks, the most decisive element was the risk assessment process that determined if the road blocks should be opened and also where they should be located in relation to the risk of a fire run. As previously described, the risk management process dependent on fire behaviour prediction was flawed by the presumption that overnight fire behaviour would not pose a serious risk to the highway.

4.4 Strategic Assessment of the Fire

The IC and SDO realized when the fire started that it could become quite large and was a threat to GEH traffic. As a fire within an extensive area of shrubland in hot dry conditions it was recognized as having the usual elements of a Goldfield Region fire, with the added complexity of the proximity of the GEH and infrastructure corridor. In hindsight, this initial appraisal did not foresee the full potential of the fire to become an extended suppression campaign that could compromise the GEH for a lengthy period. The assessment of the fire on Friday 28 was consolidated on Saturday 29 with the adoption of the strategy to try and keep the fire north of the GEH. Impressive progress on fire containment line construction on Saturday on sector A and sector C gave the IMT the reasonable expectation that the strategy might succeed. Planning for Sunday 30, both formal (IAP) and informal (IMT discussions) identified the strategic ‘hinge point’ of containing the fire on sector C to avoid it threatening the GEH and greatly expanding to the south. This was a new and unexpected contingency caused by a narrow run of the fire to the north west from near the point of origin. It made sector B obsolete, the current strategy irrelevant and reduced the chance of containment as it threatened a breakout much closer to the GEH and presented a flank fire that would become a head fire with the onset of the very strong northerly winds and high temperatures forecast. On Sunday 30 the strategic attention to sector C gave way to an evacuation from an intense fire breakout and a focus on making the GEH traffic safe. The potential to lose the fire from sector C was recognized beforehand and in a strategic sense it was understood it would mean

another large fire run through shrubland away from the GEH just like that on Friday and Saturday; but to the south. Although there was no formal documented plan prepared on Saturday or Sunday for dealing with a fire breakout from sector C, the IC, OO and PO realized that it would simply require a response similar to that already adopted, that is, a direct flank attack when fire intensity allowed. The crucial strategic issue turned out to be the anticipation of the next major hinge point, caused as before, by a change in wind direction and strength. Unfortunately this critical inflexion point was not appreciated because one of the background strategic concepts influencing the IMT was that the fire would not progress much at night when the wind change was due. This strategic conception was founded on the general history and experience of fire behaviour in these fuels in this region, wherein fires usually did become quiescent overnight. This expectation would also be a repeat of their actual fire experience on Friday and Saturday. They saw no reason to expect anything different and the cryptic warning in the spot forecast was not translated into a quantified projection of fire behaviour as a GFR shrublands fire behaviour table did not exist and the possible surrogate, the South Coast Mallee Heath Fire Behaviour Table, was not recognised by DEC or the IMT as being applicable in this setting. The planning response was therefore to prepare an IAP on Sunday evening for Monday 31 December that discounted the influence of the overnight south westerly wind change but took account of it becoming south eastly during the day that would actually assist their strategies for containment on sectors X and Y.

The deployment of resources was matched to the initial fire condition but as it turned out not to its full longer term strategic potential. Similarly, the difficulties associated with amassing large numbers of travelers at remote road blocks were not fully envisaged. Solutions such as escorted convoys evolved locally rather than being anticipated, planned and shared with central agencies. The response to the fire was conventional in that it deployed what was considered adequate at the time with the option of scaling up as required. In doing so it was already a more substantial response to Goldfields fires than is customary. A small scaling up on Saturday was followed by a decision on Sunday afternoon for a full preformed team deployment the following day. Unfortunately the tragedy intervened before this was in place.

DEC's review has decided that the response to the fire by the IC and SDO was conventional and justifiable, but was in retrospect inadequate for the strategic potential demands of the fire. There are many influences that contributed to this situation that are described in detail in the PIA, the main one being the 'standard' concept of Goldfields fires largely self extinguishing when they inevitably run into low fuel areas. Although such fires are large and damaging to the mallee heathlands, there are usually few important constructed assets threatened and so it is simply a matter of catching up with the extensive fire perimeter and steering the head fire in the most advantageous direction. At Boorabbin there was a critical exception to the usual fire situation, and that was the traffic on the Great Eastern Highway and the service infrastructure parallel to the highway. The potential impact on these assets was also underestimated because the early strategic assessment of the fire only predicted two runs, one north away from the highway on Saturday and the other south across the highway on Sunday if it was not arrested by the suppression strategy. The third fire 'run' on Monday (presuming daylight only active

fire behaviour) was recognized in the Sunday IAP as a south easterly wind influence on sectors X and Y that would be helpful to the containment strategies. The strategic assessment of the fire was done in detail in daily timeframes for the next shift, rendering it more tactical in nature with the night time period discounted based on the diurnal fire model. What was required to fully assess the strategic potential of the fire from the outset was a very simplistic vectoring of the fire runs based on the four day forecast using little more than wind direction. It is unlikely that such a prognosis would have determined the exact timing of the fire runs or have picked up the flaw in the night time fire behaviour expectation for the reasons previously explained, but it might have set the scene for an early full preformed team deployment and perhaps alerted the agencies to a potentially more prolonged impact on the highway. It is possible that other benefits might have flowed from a strategic analysis of this kind, such as a more experienced IC triggering the OAMG on Saturday and the planning team being more focused on fire prediction and longer term planning.

4.5 Conclusion

DEC appreciates there are lessons to be learned about 'standard fire models' in the GFR shrubland environment, quantitative technical fire prediction, risk assessment, planning and management processes and road traffic management. The concept of scalable and discriminating fire responses and commensurate resourcing remains, but should be subject to better and more formal strategic assessment and shared decision making. It is essential that hazard management agencies (HMA) and their supporting agencies work to agreed guidelines on common tasks. The management of roadblocks at fires evidently needs improved and better documented procedures and training. HMAs and supporting agencies all need to be familiar with the common guidelines and capable of working together to bring them into full effect at incidents. Vehicle Control Point Guidelines have been prepared by relevant agencies and are being applied at recent incidents.

There are a number of other unique aspects of the Boorabbin fire that in combination contributed to the tragic outcome. However for summary purposes the three critical factors described above are considered to be the primary issues and the main lessons to be learned.

DEC has thoroughly examined all known aspects of the Boorabbin fire. There are many aspects of the incident that have produced important changes and improvements to DEC's standard operating procedures for fighting wild fires, particularly in remote regions in shrubland fuels. The details are captured in the PIA and the Findings and Actions documents. The GHD Fire Development Chronology and Operational Review reports have objectively corroborated and extended DEC's findings. DEC has worked with other authorities to improve interagency guidelines such as the Draft Vehicle Control Point Guideline and will continue to do so for the coming fire seasons. DEC will implement the relevant recommendations of the Coroner.

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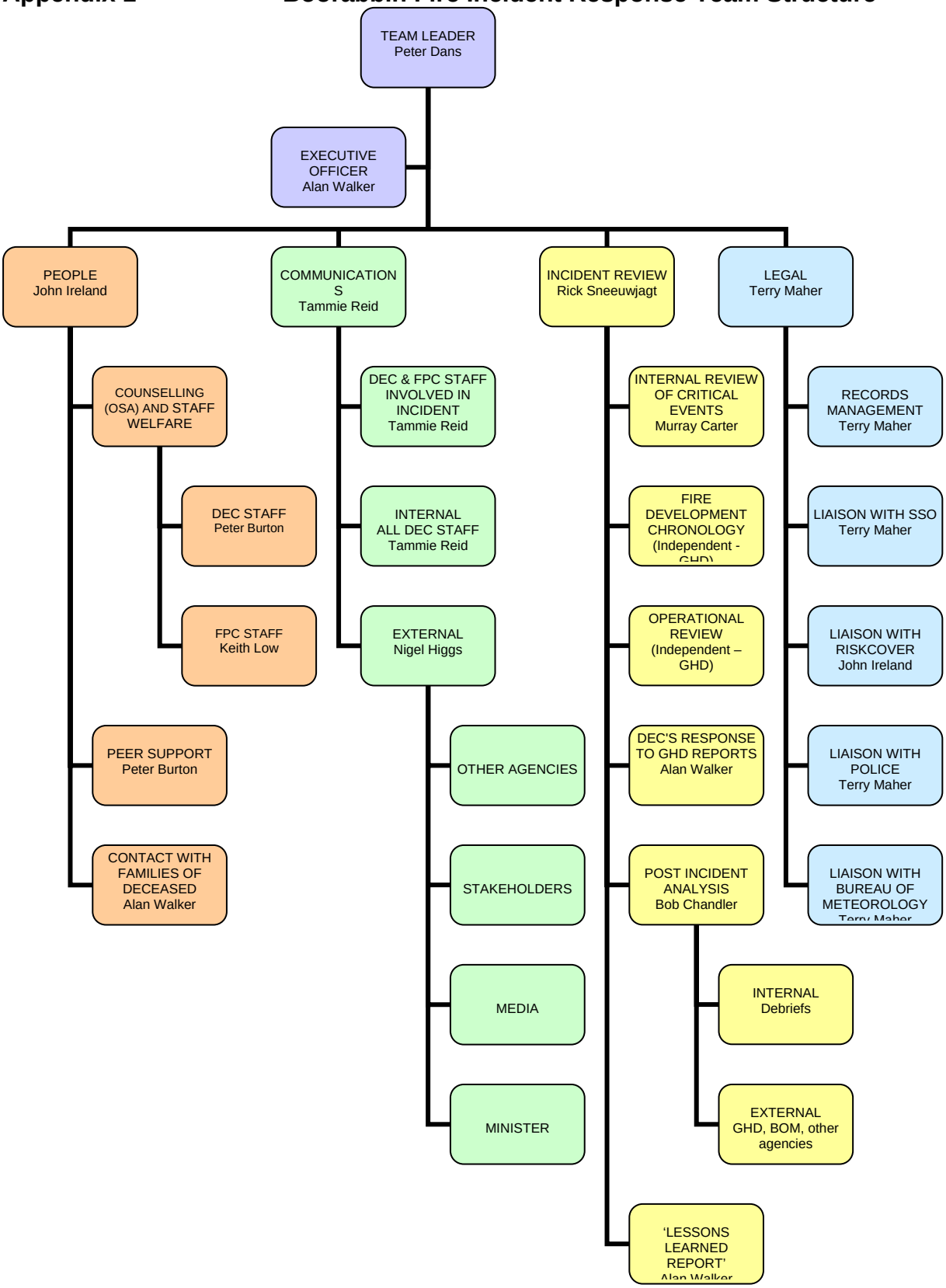
APPENDICES

Appendix 1 - Boorabbin Fire Incident Response Team Structure



Appendix 2

Appendix A

Goldfields Fire 13 – Operational Review: Terms of Reference

CONTRACT BRIEF - GOLDFIELDS FIRE 13 OPERATIONS REVIEW

VERSION 140208

BACKGROUND

A wildfire known to the Department of Environment and Conservation (DEC) as Goldfields Fire 13 burnt 43,000 ha of natural woodlands and heath vegetation in the period 28th December 2007 to 8th January 2008 in the vicinity of the Boorabbin National Park on the Great Eastern Highway between the towns of Coolgardie and Southern Cross.

The fire was fought by a multiagency team lead by the Department of Environment and Conservation as the agency responsible for fire management and suppression in national parks.

On 30th December 2007 two trucks were incinerated when the fire intercepted them on the Great Eastern Highway. Three occupants of the trucks were killed. A coronial inquiry will be conducted into the circumstances of the fire.

DEC is undertaking a series of reviews of the fire and related matters (see diagram attached) to determine the facts and to identify lessons that might improve future fire suppression. The reviews will be made available to the Coroner.

Independent professionally qualified consultants will undertake two of the reviews, namely the *Fire Development and Chronology* and the *Operational Review*. This call for tender relates to the second component, the *Operational Review*. The two reviews are related as an understanding of the behavior of the fire explains the context in which the fire suppression activities were conducted.

SCOPE

The objective of the review is to give an accurate and discriminating account of the operational management of the fire sufficient to identify and explain the causes and contributing influences that resulted in significant fire outcomes. The review will cover two time frames during the course of the active fire; from the start of the fire until 0600 hrs on 31st December 2007 and from 0600 hrs on 31st December to the fire being declared controlled and mopped up on 9th January. The intensity of the review for each period will be that required to meet the objective of the study. The consultant will also consider aspects of fire planning and preparation in

the Goldfields Region prior to the Boorabbin fire. A brief commentary on the status of fire planning and fire preparedness in the Department at large will also be required.

The Review will be done in the context of the *Australian Inter-service Incident Management System (AIIMS)* that is the operational methodology used by DEC and associated agencies for wildfire management. The preparation of plans, objectives and strategies for the management of the fire as described by the AIIMs procedures, particularly with respect to the safety of fire fighters and the public, will be relevant. The contractor will employ a *'Prevention, Preparedness, Response, Recovery' (PPRR)* approach so the report presents a strategic and regional context for DEC's management of wildfire whilst elucidating the specific details of this fire incident. Subject to the scope of the review, the contractor will broadly adopt the principles and procedures outlined in DEC's Fire Operational Guideline 31 (FOG 31 – see attached) that sets out the Department's approach to After Action Review (AAR) and Post Incident Analysis (PIA). The contractor will review the application of DEC's *Standard Operational Procedures (SOP)* and *Fire Operational Guidelines (FOG)* relevant to the incident (attached), and recommend any improvements or changes that in their professional opinion might be warranted as a result of this fire experience. Only those SOPs and FOGs deemed relevant to this incident need be reviewed. It is expected that an examination of the efficacy and application of DEC's SOPs and FOGs in the context of AIIMS will constitute the main body of work for the Operational Review.

The consultant will produce a statement of 'conclusions' from the review that links to a set of 'recommendations'. This section of the report to be titled 'Lessons Learnt'. The conclusions, recommendations and lessons learnt may in part be qualified and conditional as determined by the scope of the review and available information. Specific limitations that can be reliably anticipated will be specified in the contract where possible, otherwise they will be explained in the report.

The consultant will use the *Fire Development and Chronology Review* to inform the *Operational Review*, and vice versa as necessary.

The consultant will make a brief comparison of DEC's wildfire management with comparable best practice in Australia relevant to, and limited to, the principal findings in the Review. The purpose of the comparison is to highlight the practices of other wildfire management jurisdictions that might be instructive for DEC or for other State emergency management authorities, or the Coroner. The comparison is not intended to be an exhaustive analysis, but rather to identify key issues and point to further lines of enquiry that might contribute to DEC's 'Lessons Learnt' document.

At an earliest possible stage of the review the consultant will discuss their initial key findings with DEC to provide an opportunity to refine the critical lines of enquiry and define the ongoing scope of the review. DEC's purpose will be to ensure the consultant is focused on the essential aspects of the enquiry so that all of the facts and information necessary for the proper and complete elucidation of the event emerge. A final draft of the Review Report will also be provided to DEC in order to allow checking for factual accuracy.

As this review is likely to be material to the Coroner's enquiries, DEC will expect the consultant to exercise complete professional integrity and independence from DEC's reviews and findings, notwithstanding that all information about the fire in DEC's possession will be made available to the consultant. It is expected that much of the information that is a matter-of-fact required by the consultant will be available from the AAR and PIA processes undertaken by DEC. Whenever possible, the consultant will attend DEC's debriefings and reviews as an observer. The consultant will indicate the origin and status of key information or views in the Review Report. It is expected the consultant will employ various methods for gathering information that will include direct interview of DEC staff, reference to operational records from the fire, post fire statements and documents, direct field observations, DEC SOPs and FOGs, national AIIMS documentation, DEC policy statements and other related documents, fire management published documents from other sources, and professional knowledge, judgment and experience. DEC will assist the consultant with the provision of documents, maps and records as needed, and full access to DEC staff as required. The consultants will have access to DEC offices and workspace as needed by arrangement.

The prime focus of the review is on DEC's operational management of the incident and DEC's formal responsibilities in these situations. The review will also examine the multi agency interaction at this fire and consider its efficacy at the operational level. The interagency aspects of the Review will be conducted through interviews with relevant IMT leaders prior to the 31st December, the DEC Goldfields Regional Manager and the ICs from Gold and Black preformed teams. The consultant may wish to interview a limited number of non DEC personnel (subject to availability) who may be able to contribute to this aspect of the review.

Whilst it is expected that the Coroner will find the review very helpful, the scope of the review will not cover the whole likely ambit of the Coroner's enquiries and interests, particularly with respect to the interview of people not employed by DEC. Likewise, the statements, documents and information gathered by the Coroner through the police and others might not necessarily be available to the contractor. Specific information needed by the consultant might be requested from the Coroner on advice from the State Solicitors Office (e.g. Coroner's Bureau of Meteorology Report). The consultant should be prepared for the possibility they will be called by the Coroner to give evidence and explain aspects of their Review Report.

REVIEW SUBJECTS

This list of subjects is provided as a guide to the consultant and is essentially chronological. The list aims to capture an adequate strategic context for this fire event whilst concentrating on the operational management of the fire in relation to the efficacy and application of DEC's wildfire management SOPs and FOGs in the AIIMS environment. The intensity and scope of enquiry into each aspect and phase of the fire will be progressively assessed to ensure the most informative and useful outcome is achieved in the public interest.

Prevention

1. DEC's fire management function, organization and operations
2. DEC's fire management organization and traditional practice in the Goldfields Region
3. DEC's Widlfire Threat Analysis (WTA) and Fire Prevention Plan for Crown Lands Between Coolgardie and Southern Cross
4. Interactions with other Emergency Management Authorities at State and Goldfields Regional level
5. Identification of hazards and assessment of threats to the environment, human life, public and private assets

Preparedness

1. Implementation of the Goldfields WTA Plan
2. General fire management strategies and operations in the Goldfields Region, including sufficiency of resources, level of staff experience and availability of assistance if required
3. Seasonal fire management 2007/2008 in Goldfields Region
4. DEC fire management context for 2007/2008 season
5. DEC fire situation pertaining in December 2007 and January 2008
6. DEC fire preparation 28th December 2007 and outlook

Response

Initial phase

1 **Initial fire report and immediate actions**

2 **Initial dispatch and fire appreciation**

3 **Initial strategies and tactics**

4 **Setting up IMT**

5 **Fire behavior, development, and intelligence**

6 **Assessment of fire potential: regional and Departmental**

7 **Resourcing**

8 **Sectorisation of fire, operations point, allocation of resources**

9 **Safety assessment: hazards, risks, priorities**

10 **Strategies and actions for management of risks to fire suppression personnel and members of the public**

Escalation phase north of Great Eastern Highway

1 **Fire behavior, projected development and weather forecasts**

2 **Fire line production and fire containment**

3 **Fire planning, intelligence, mapping, IAP**

4 **Strategy and objectives for containment north of the Great Eastern Highway**

5 **Operations on shifts 1 to 3 (28th & 29th December): progress and issues**

6 **Safety management strategies and operational application**

7 **Specifics of traffic management on the Great Eastern Highway: intended and actual**

8 **Shift changes and overnight situation**

9 **Night time firefighting in the Goldfields**

10 **Fatigue management and firefighting conditions**

Escalation phase south of the Great Eastern Highway 30th December 2007

1 **Strategy and IAP for 30th December**

2 **Weather forecast and fire development risks**

3 **Deployments of resources on 30th December**

4 **Fire breakout to south and crossing of the Highway: cause and progress**

5 Response to fire breakout

6 Strategy and implementation of strategy to pursue the fire

7 Fire behavior in woodland fuels, low fuels (fire scars, salt lakes) and against firebreaks

8 Traffic management on the Highway in periods AM and PM to nightfall: intended and actual

9 Management and support of travelers at road blocks

10 Public reaction to road closures and influence on IMT and IAP based on IMT interviews and news media reports

11 Intelligence: ground and air

12 Fire line production and efficacy of strategy

13 Safety of fire crews

14 Deployment and function of other agencies, role of OAMG

15 Functionality of the IMT and its components

16 Public information produced by the IMT

17 Observed fire behavior: afternoon and in evening and wind influence

18 Predicted fire behavior: afternoon and evening and influence of weather forecast

19 Traffic management on the Highway after nightfall and departure of helicopter: intended and actual

20 Overnight fire management strategy

21 Knowledge of fire position, extent and fuels

22 Revisions and amendments of the IAP on 30th December

23 Decision to send more resources and upgrade fire status

24 Traffic management at the time of the fatalities

25 Fire behavior at the time of the fatalities

26 Response of agencies to the fatalities in relation to fire management and Highway management overnight.

Post 30th December Fire Phase – Shifts 5 – x

1 Apply selected components of the DEC Post Incident Analysis process (Fire Operations Guideline 31) as required

2 Focus on aspects that relate to any key pre 30th December matters

3 Identify any significant issues or outcomes that might improve DEC's fire management practices

4 Review ongoing management of the fire and functionality of the IMTs

5 Give an account of the ongoing management of traffic on the Highway to the conclusion of the fire

6 Review fire strategies implemented after 30th December including alternative or fall-back strategies

Recovery

1 Note the recovery process for the restoration of Highway traffic.

2 DEC has implemented a process of After Action Review (AAR) and Post Incident Analysis (PIA) as indicated in the attached diagram. Comment on the efficacy of the process and any improvements as appropriate.

REVIEW REPORT

1 The Review Report will be structured to clearly show the chronology of events and the relationship of key outcomes in time.

2 The Review Report will be structured in two parts to distinguish the events prior to the deaths of three members of the public on the Great Eastern Highway and those events coming after to ensure there is a suitable concentration on key issues.

3 The Review Report will necessarily focus on DEC staff and DEC activities but will as far as possible within the resources and information available to the consultant also cover other people and agencies that had a significant role in the fire. It is appreciated that the extent of access to non DEC staff and to documents or information held by other parties cannot be predetermined.

Spot Fire Weather Forecast 1 General

IDW31400

Australian Government Bureau of Meteorology
Western Australia

SPOT FORECAST

Issued at 9:13am WDT on Sunday the 30th of December 2007

DO NOT USE AFTER 2200WDT

Location	Boorabbin	Organisation	DEC	Requesting officer:	Murry Mitchell
Lat/Long	31.2S 120.2E	Phone 1:	93340375	Fax 1:	93679913
		Phone 2:	0429886467	Fax 2:	97614437

Observed conditions at:	Southern Cross AP				
Time (WST)	Temp (C)	Dew Pt (C)	RH (%)	Wind (km/h)	Weather/Remarks
0900	33	8	21	NE 33 gusts 44	Fine

Forecast conditions				
Time (WST)	Temp (C)	DewPt (C)	RH (%)	Wind (Km/h)
1000	37	6	15	NNE 36 gusts 55
1300	41	4	10	NNW 38 gusts 55
1600	43	2	8	NW 30 gusts 45
1900	41	4	10	W 35 gusts 50
2200	33	8	21	SSW 28 gusts 35

Significant Wind Change S/SW change expected at site approx 1900-2000
Weather/Remarks Fine. Gusts to 65kmh possible with SW'ly change.

Outlook
Monday: Fine. Max T = 32C. Min RH = 20%
AM Winds: SSE 25 kmh
PM Winds: SE 25 kmh.

Forecaster Chris GS Phone:(08) 9263 2260 Fax: (08) 9263 2261
Please ensure regular observations are passed back to the Fire Weather Forecaster.
Contact the Fire Weather Forecaster for additional forecasts and updates.

Attn Planning Section

IDW81400

BUREAU OF METEOROLOGY
WESTERN AUSTRALIAN REGION

SPOT FORECAST

Issued at 5:09pm WDT on Sunday the 30th of December 2007

DO NOT USE AFTER 0600WDT

Location	Boorabbin	Organisation: DEC		Requesting Officer:	Murry Mitchell
Lat/Long	31.2S 120.2E	Phone 1:	93340375	Fax 1:	93679913
		Phone 2:	0429886467	Fax 2:	97614437

Observed conditions at: Southern Cross AP

Time (WDT)	Temp (C)	DewPt(C)	RH (%)	Wind (km/h)	Weather/Remarks
1700	42	-5	5	NW 31 gusts 43	Fine

Forecast conditions

Time (WDT)	Temp (C)	DewPt (C)	RH (%)	Wind (km/h)
1800	40	-5	6	NW 25 gusts 35
2100	34	6	18	SSW 30 gusts 45
0000	26	13	45	SSE 30 gusts 45
0300	20	12	60	SSE 25 gusts 38
0600	17	10	63	SE 28 gusts 40

Significant Wind Change	S/SW change expected at site approx. 1900-2000. Gusts to 50kmh possible.
Weather/Remarks	Wind strength could also drop to 10-20kmh in the hour preceding the change. ***UPDATED*** Note that there is some uncertainty in exact timing of wind change, due to lack of monitoring equipment west and south of Sthn Cross.

Outlook

Monday: Fine. Max T = 32C. Min RH = 20%
AM Winds: SSE 25 kmh, gusts to 40 kmh
PM Winds: SE 25 kmh, gusts to 45 kmh

Forecaster: Chris GS	Phone: (08) 9263 2260	Fax: (08) 9263 2261

Please ensure regular observations are passed back to the Fire Weather Forecaster.
Contact the Fire Weather Forecaster for additional forecasts and updates.

30/12 2007 17:11 FAX 97614437 001/001

Appendix 4

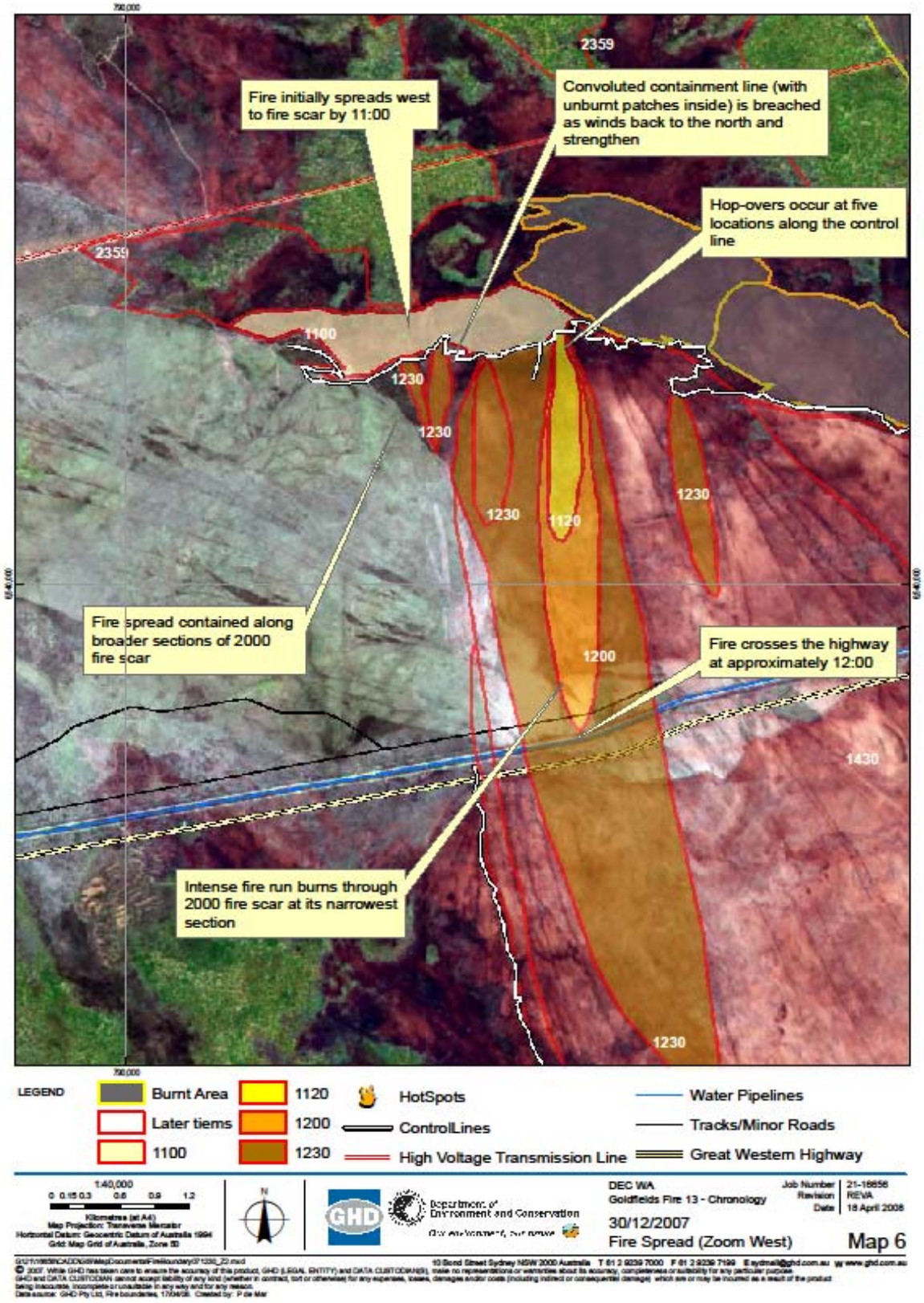


Figure 1 Fire spread between 1100 and 1230 on 30 December 2007 (from GHD Chronology, June 2008)

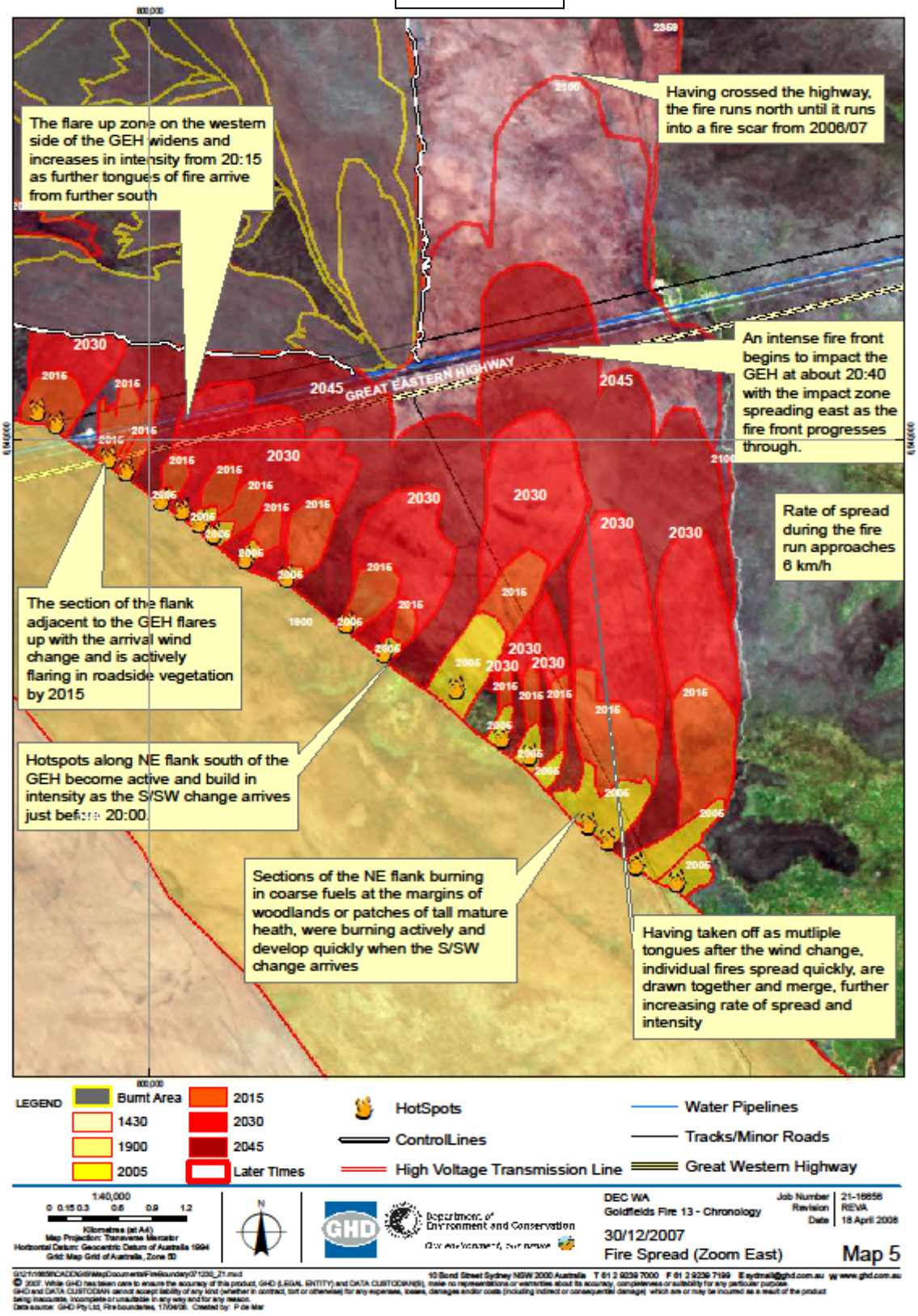


Figure 2 Fire spread 1430 to 2045 on 30 December 2007 (from GHD Chronology, June 2008

Appendix 6

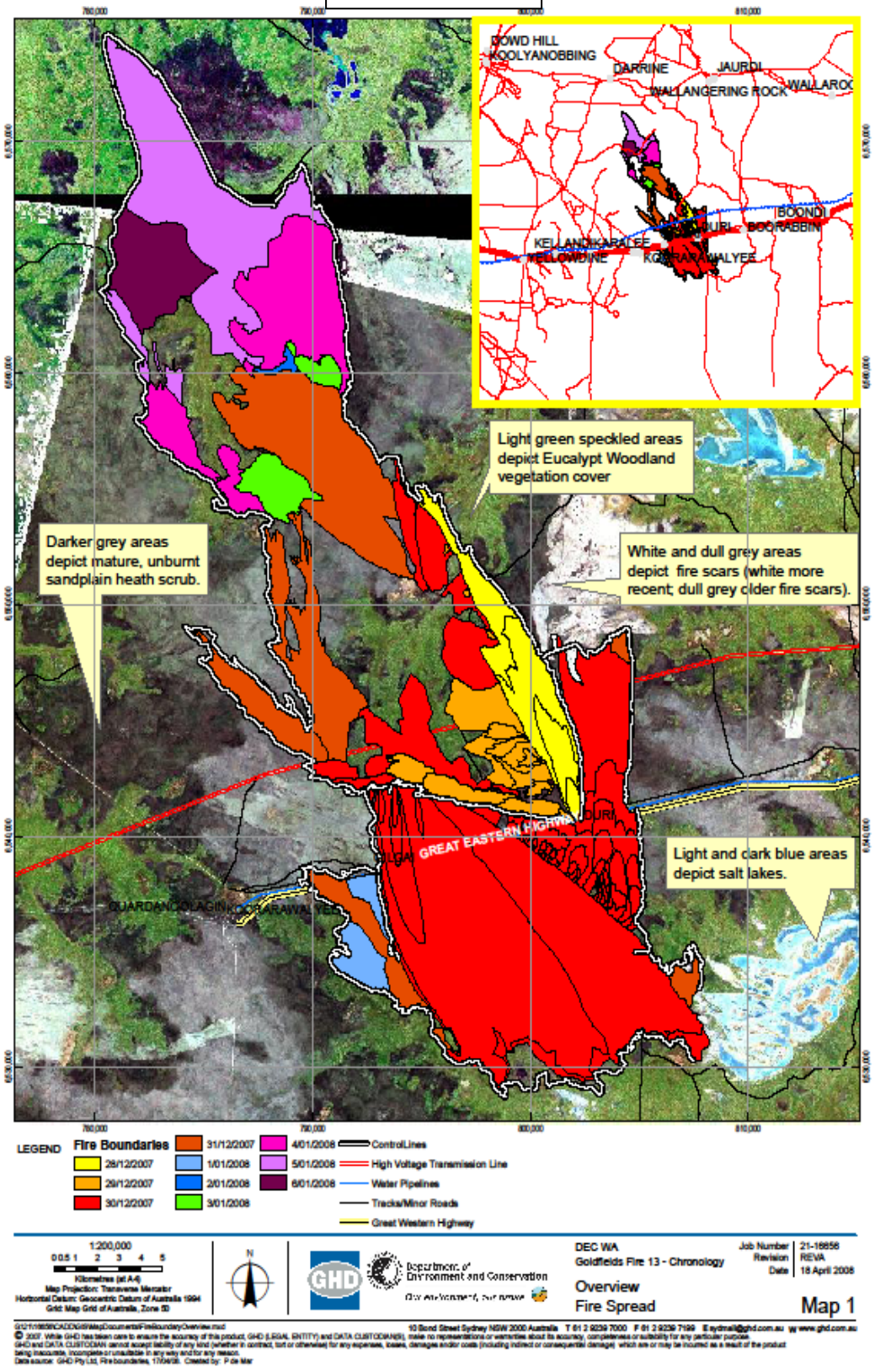


Figure 3 Fire boundaries from 28 Dec 2007 to 8 Jan 2008 (from GHD Chronology, June 2008)