

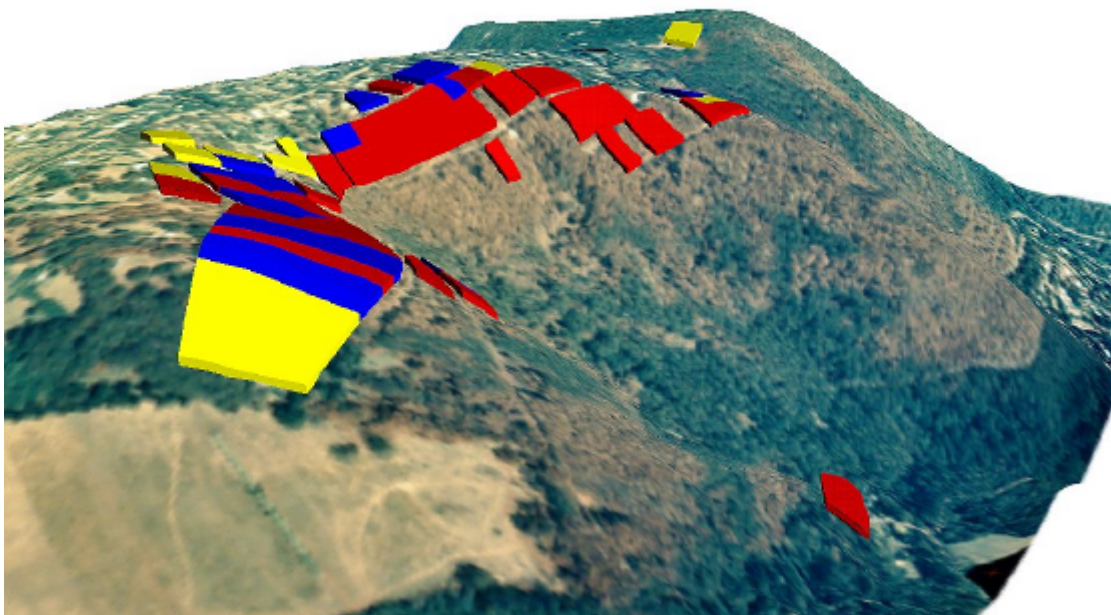
**EMSINA**

Emergency Management Spatial Information Network Australia

## **A review of the use of Geographic Information System Technologies in Bushfire Management**

**A submission to the Council of Australian Governments  
Inquiry on Bushfire Management, Prevention and Mitigation  
By EMSINA**

**24th February 2004**



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## 1. Introduction

As much as eighty percent of information used during emergencies is 'spatial' information, having a location component such as an address or a map reference. Most of Australia's Emergency Services now use Geographic Information Systems (GIS) to manage complex spatial information on the environment, infrastructure and operational matters. In recent times GIS has played a significant role in many emergency management disciplines such as bushfires, counter terrorism, animal disease outbreaks, floods, severe storms and earthquakes.

As GIS technologies have become increasingly integrated with a number of allied hardware and software technologies such as remote sensing, Global Positioning Systems (GPS) and hand held computers, these "intelligent mapping systems" have become flexible and widespread in their use. However many emergency services in Australia have not yet derived full benefit from the employment of GIS as a tool of the trade. This requires a significant internal investment in money and people as well as full cooperation from many other Government and private institutions.

In October 2002 at the national GeoInsight workshop in Canberra, around 80 participants agreed that tremendous efficiencies could be gained by interstate co-operation in the development of spatial information systems. The Emergency Management Spatial Information Network of Australia (EMSINA) was formed to represent state GIS User Groups and the federal emergency management sector .

EMSINA has developed a constitution, attracted seed funding and laid out a plan for future activities. These include:

- Providing a practitioners voice in national consultative processes
- Establishing common operating procedures and assisting in the development of standards
- Establishing a national skills register to assist in the deployment of GIS staff to emergencies
- Organizing workshops to promote the use of GIS across the sector
- Sponsoring the development of state based emergency management GIS user groups, often where there weren't any and with general success

This submission has been prepared by EMSINA which now represents over fifty state based emergency management agencies and three significant federal bodies. Five of the state representatives on EMSINA are full time employees by bushfire management agencies.

## 2. Bushfires, Mapping and Geographic Information Systems

Bushfires are a major natural and socio-economic hazard in Australia. On average unplanned fires affect several million hectares of land per annum, with many more millions of hectares coming under threat. In a severe year, these figures may increase dramatically. Tragedies such as: the Tasmanian fires of February 1967 (62 deaths, more than 1400 buildings destroyed); the Ash Wednesday fires of February 1983 (71 deaths in South Australia and Victoria, more than 2,500 buildings destroyed); and, the

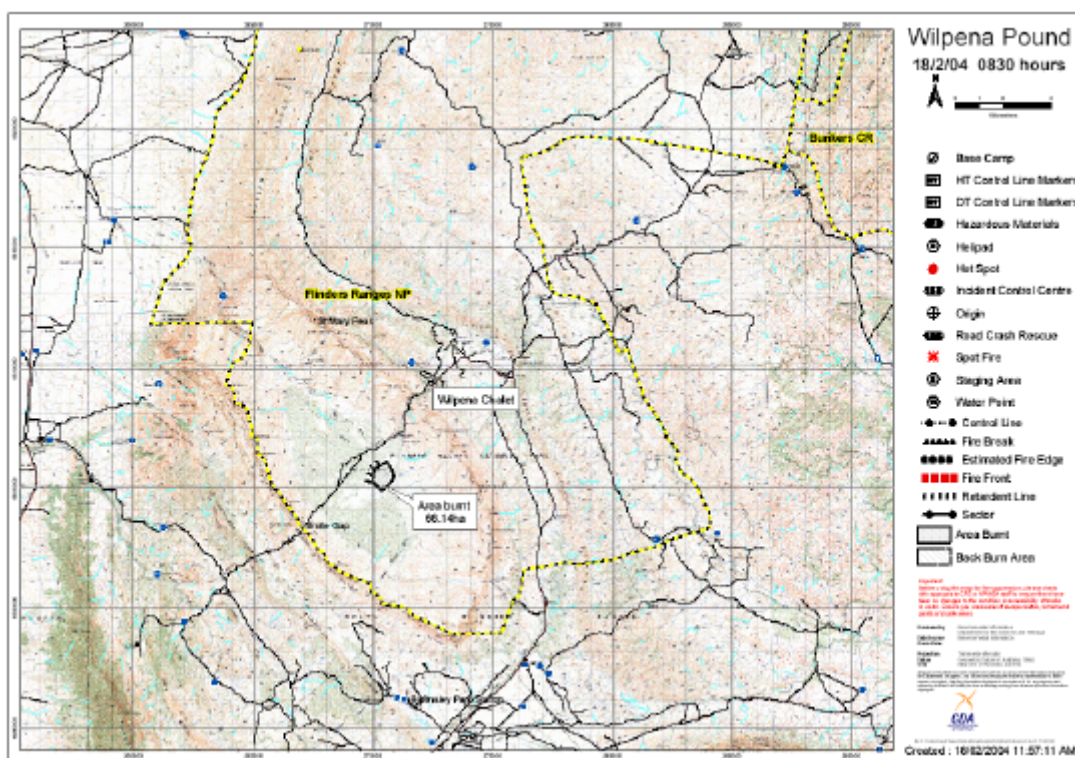
more recent fires in New South Wales and the Australian Capital Territory highlight the severity of the hazard that wildfires pose. The rapidly expanding coastal cities of Australia compound this already serious situation, with the number of people living in the urban-rural interface, in 'bushfire prone areas', growing each year.

By the mid 1990s many state and regional fire-fighting authorities in Australia, and indeed worldwide, had initiated development of bushfire mapping and management capabilities based around the use of GIS.

GIS is widely used in the management of bushfires and provides important benefits in all aspects of emergency management processes (planning, preparedness, response and recovery).

Examples of applications include:

- ***As a decision tool for managing fire hazard reductions:*** Topographic and vegetation features can be visually represented and analysed in relationship to previous bushfire paths. Hazard reduction activities can be planned and managed to prevent or minimize future impacts
- ***Resource allocation and planning tool:*** Data on previous fire ignition locations, including deliberately lit and lightning initiated fires, can inform decisions regarding the deployment of ground and aerial water bomber units during times of risk, to minimize response times.
- ***As a tool for community education:*** Maps showing high fire risk areas are used to assist in targeting community education programs and communicating the spatial distribution of bushfire risk through maps.
- ***Training and awareness:*** Allow fire trainers to replay the spread of historical bushfires to inform training exercises
- ***Logistical and coordination arrangements:*** Access to information regarding location of assets, resources etc, assists in developing strategies for accommodation of stranded tourists and interstate and international responders
- ***As a support tool for fire operations:*** Accurate and timely maps showing fire boundaries, active fire edges and other information enable fire controllers make more efficient use of fire fighting and other resources
- ***Improves safety of the fireground:*** By tracking the location of firefighting resources such as bulldozers and aircraft via the integration of GPS and GIS
- ***To keep the public informed and assist them in making safe decisions:*** Maps of bushfire locations, threatened or affected areas and other fire information can be made rapidly available (through the internet) to the public
- ***Media communication:*** Use of internet for maps, traffic routes, exclusion zones etc to assist the media in communicating situational information with the public
- ***As an aid for investigations by Coroners, Police, Insurers, Environmental groups and for other Inquiries:*** The collection and collation of details of bushfire origin, fire progressions, accidents, burnovers, property damage provide valuable information for later examination.



**Figure 1 – A recent fire in Wilpena Pound mapped by the Mapping Support Unit, a Country Fire Service and Department for Environment & Heritage initiative in South Australia.**

- ***For monitoring past and future bushfire behaviour:*** Provision of high resolution imagery from planes and satellites is imported into GIS to assist with the assessment of fire fuels. GIS can bring together and display data obtained from different sources (eg. high res from planes and satellites overlain with property boundaries and water supplies).
- ***For assisting in recovery:*** Supports recovery processes in public health, the environment and other facets of bushfire; GIS can also allow targeting of priority areas using data from community organisations, Government agencies etc. and can also assist in assessing progress of recovery.

Whilst the preceding dialogue rightly describes what is possible by the application of GIS in bushfire management there are no state bushfire management agencies capable of delivering a totally integrated fully productive GIS. A system that can achieve such a status requires a concerted push from many sectors, systems and people.

### **3. The Bushfire Inquiries and their focus on mapping and GIS activities**

The Bushfire Inquiries in Canberra, Victoria and South Australia touched on many issues that relate to GIS technologies without expressly covering them in detail. This is to be expected where such a diffuse range of topics are covered.

Whilst this report is not intended to concentrate on local GIS and mapping activities there are several issues that need to be further explained or put into a wider perspective.

### **3.1 Canberra Bushfires (McLeod and Nairn) - GIS and Mapping Issues summarised**

#### **3.1.1 Currency of maps:**

- Firefighters were hampered by the lack of up to date basic maps; Maps used were often 20 to 30 years old
- There is a need to use the right mix of technology to use it in a way that best supports operations. Good information is vital to use it in a way that best supports operations. The lack of up to date maps required urgent attention to mapping to mapping programs in the states and territories

#### **EMSINA Response:**

- The Inquiries lamented the lack of up to date mapping in the ACT. There are a number of examples of emergency management map books produced elsewhere in Australia that should be used as a template for the development of local emergency management directories
- The Inquiries missed the point that whilst 1:100,000 scale map books are used to enhance dispatch and overall management of fires the most suitable scales for most operational mapping is 1:50,000 and 1:25,000. Mapping products for these scales are the jurisdiction of state mapping agencies and therefore these organisations should also be approached to review their map production programs
- There are several examples across Australia (e.g. FireMap CD by the Fire Management Branch of the Victorian Department of Sustainability and Environment (DSE)) where topographic maps have been produced from digital GIS databases directly as digital maps. Digital maps can be regularly updated (e.g. every 2 years) and all topographic maps for the state are produced ensuring none are out of print or unavailable when an emergency occurs. The accuracy, currency and accessibility of state digital mapping databases is paramount to the success of these products.

#### **3.1.2 National spatial information issues**

- Problems impeding the development and delivery of geographical information systems for bush fire fighting. Whilst these issues are generic across the geospatial data industry they do also impinge on fire management planning, fire fighting operations and fire analysis.
- Reference data was said to be generally available (albeit at some cost) but also generally out of date and incorrect. In emergency situations it is hard to update this information without access to base data sets maintained by various governments. If the question of cooperation and policy are resolved with respect to the access to this critical data then information could be enhanced by the use of currently available technology.
- A central feature of any national approach would be a move to greater standardization of data collection and processing. According to the Australian

Spatial Information Business Association (ASIBA) there would be several benefits of this approach:

- Standardization lets peers communicate.
- Minimizes cost of uptake of new information.
- Maximizes utility and stability of information products.
- Permits more applications to operate under known conditions.
- This approach would require that there be a coordination agency which ASIBA suggested could be GeoScience Australia (GA) or Emergency Management Australia.
- ASIBA argued that spatial information needs to be used in a proactive way and not just accessed during major emergencies. It was proposed that there be a national Spatial Data Policy that provides for free access to base spatial data held by governments across the country.
- ASIBA has found that there is little leadership shown at the national level on this issue and that EMA seemed reluctant and disinterested in developing the opportunities to improve access to data and its use prior to and during emergencies. The development of a national policy and supporting programs should be a matter taken up by GA with EMA in a supporting partnership role in assisting with the dissemination and uptake of geographical information technology.

**EMSINA Response:**

- The issue of national coordination of spatial information industry extends much further than the management of bushfires. Local, State and Federal Government Agencies are involved in emergency management and the sector generically covers many other hazard types such as flood and earthquakes. Policy makers, practitioners and products suppliers all have a stake in the industry and can contribute to the ongoing improvement in the use of GIS.
- GA and EMA, whilst being significant players in the federal sector do not engage significantly with the state and local emergency management industry where the majority of emergency management mapping and GIS implementations are found.

## **3.2 Victorian Bushfires (Esplin Inquiry) - GIS and mapping issues summarised**

### **3.2.1 Standards and protocols for exchange of information**

- That DSE and Country Fire Authority (CFA) review the standards and protocols for documentation, including mapping, provided to fire line managers as part of their briefing notes, to ensure these are concise and appropriate.

**EMSINA Response:**

- Consistency and standardization of GIS and mapping product is important. EMSINA actively promotes the development of common operating procedures and is working on the development of standard mapping symbologies

### 3.2.2 Co-operation between agencies

- That DSE, CFA, Melbourne Fire Brigade (MFB) and Victorian State Emergency Service work co-operatively to establish a common system for resource tracking during major fires and incidents.
- That a single state-of-the-art all hazards State Emergency Operations Centre be established for Victoria.
- We recommend an 'all hazards – all agencies' capability within the State to eliminate duplication and streamline decision-making and reporting.

#### **EMSINA Response:**

- EMSINA's membership responds to a diverse range of hazards including event management, floods, earthquake, structure fires and bushfires. EMSINA supports an all-hazards approach to the development of emergency management GIS as the base data, information and systems are common across the sector

### 3.2.3 Priority of information management

- That all emergency service agencies, ...give greater priority to information management – especially the collection, maintenance and quality control of base data sets necessary for planning, operations and program evaluation.
- That Government acknowledges the importance of spatial information as a key element of planning, operations and program evaluation, and support the Geospatial Emergency Information Network (GEIN) as a means of ensuring integrated and coordinated information management on a whole-of-Government basis.

#### **EMSINA Response:**

- This is totally supported by EMSINA. It is vital that all information, not just spatial information is timely, accurate and fit for use.

## 4. GeoInsight - Barriers to the application of GIS in the emergency management industry

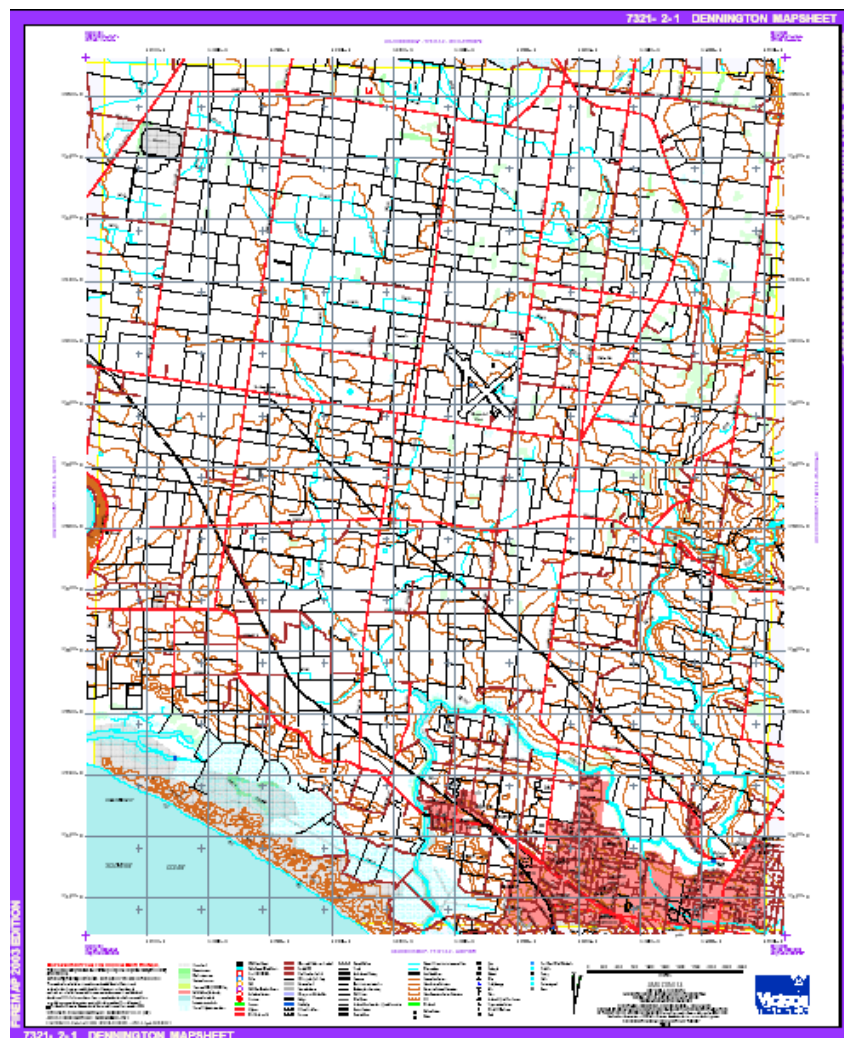
In 2001 the federally funded GeoInsight Project endeavoured to achieve a wider use of GIS throughout the emergency management community in Australia. It brought together the spatial information and emergency management community to create a better understanding of each other's capabilities and needs.

GeoInsight endeavoured to increase the awareness and uptake of spatial data throughout Australia's emergency management industry and to foster a strong relationship between Australia's Emergency Management industry, spatial data suppliers and value-added resellers

Through the course of the project GeoInsight identified significant barriers to uptake of GIS. The barriers included:

- Lack of awareness at senior management level
- Suitable industry specific cost-benefit analyses did not exist
- A shortage of spatially skilled operatives
- Lack of suitable telecommunications bandwidth in non-urban areas
- State Government data pricing policies restrict the uptake of spatial information
- Lack of understanding by the industry of the real needs of emergency management when providing software, hardware and training

These issues remain some of the true barriers that exist in the use of GIS to combat bushfires and other hazards in Australia.



**Figure 2 – FireMap CD stores digital maps covering all of Victoria that are able to be opened into Acrobat – a free viewer downloaded from the Internet**

## 5. Discussion of major issues

The following section describes a number of issues of national importance in the deployment of GIS in bushfire management. Several of the issues already highlighted in the Section on the Bushfire Inquiries are repeated here.

### 5.1 State digital mapping programs are vital

The delivery of products and services by Bushfire Agencies is mostly achieved through local sources. For example local fire brigades are normally the frontline troops for fire control and fire management plans are often based around protection of towns. Mapping and GIS products that support these services are the jurisdiction of state mapping agencies.

The Emergency Services in some states are well resourced with access to map directories and good local maps. For example in Tasmania the 1:12,500 Scale Street Atlas product (1 per vehicle) and printed 1:25,000 map sheets for the relevant brigade response area are readily available. Digital Data for these products is freely available at cost of transfer to emergency managers via a dedicated and secure server and this is used to load appropriate data onto all field computers.

#### **EMSINA:**

- Stresses the importance for state governments to maintain an up to date, consistent and accessible GIS base data.
- Recognises the important role that hardcopy maps play in risk management and emergency services planning and response and recommends that State mapping agencies review their hardcopy mapping programs.
- Supports the coordination of hardcopy mapping across the various sectors of government.

#### **5.1.1 Currency of Spatial Information**

McLeod & Nairn lament the lack of up to date mapping in the ACT, with firefighters using maps that were often 20 to 30 years old<sup>1</sup>. EMSINA supports the accompanying recommendation that state mapping programs require 'urgent attention'. The lack of currency presents problems across the State, but especially so in our understanding of the built environment and infrastructure. From an emergency management perspective, accurate information on roads and tracks is crucial, whilst in the more urbanised areas, new infrastructure and roads are being constructed which very quickly renders the hardcopy products out of date and in some cases, dangerous.

A recent Victorian forum to address the issue of the accuracy, currency and availability of hardcopy maps<sup>2</sup> demonstrates the widespread problem of outdated hardcopy maps, with 39 % of the State's current hardcopy topographic maps over 20 years old.

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<sup>1</sup> McL&N also noted that there is a need to use the right mix of technology to use it in a way that best supports operations. Good information is vital to use it in a way that best supports operations.

<sup>2</sup> Geospatial Information Reference Group (GIRG) Wednesday July 23rd. 2003 on "Hard Copy Topographic Maps – Exploring the Issues.

EMSINA points out however, that there are a number of examples of Emergency Management map books produced in other States that provide a well tested template for the development of local emergency management directories. For example, the CFA Map book includes 1:100,000, 1:50,000 and 1:25,000 scale maps with specific overlay data produced for and available in every CFA Fire vehicle. South Australia and Western Australian have produced similar directories in the last few years. In emergency situations, especially bush fires there is an increasing reliance on these mapbooks with specialised overlays to describe and locate the emergency along with manpower and equipment resources.

There are several examples across Australia (e.g. FireMap CD by DSE) where topographic maps have been produced from digital GIS databases directly as digital maps. These techniques provide the advantage of being able to be regularly updated (e.g. every 2 years) and all topographic maps for the state are produced ensuring none are out of print or unavailable when an emergency occurs. The accuracy of state digital mapping databases is paramount to the success of these products.

### **5.1.2 Map scale – Support from of EM Agencies by State and Local Government**

Emergency Services, especially bush fire fighting, require highly detailed maps. Although nationally produced 1:100,000 and 1:250,000 scale maps<sup>3</sup> are useful to enhance dispatch and overall management of fires, maps at this scale simply do not contain enough detail. The most suitable scales for most operational purposes are 1:50,000 and 1:25,000.

This issue of scale is critically important, because the base mapping products at 1:25K and 1:50K is the jurisdiction of state mapping agencies (usually the land management departments). The accuracy of state digital mapping databases is paramount to the success of all value added mapping products and use in intelligent mapping systems by emergency services.

### **5.1.3 Cost of access to digital data**

Access to data is restrictive in some state and local government jurisdictions and costs in particular remain a barrier to full uptake of the technology. The move by the Federal government several years ago to all the spatial data that it is responsible for free is welcomed and should be followed by state and local Governments.

Each state has their own method of preparing and delivering digital data used by emergency services. Some digital data is poor quality and in some cases emergency management agencies are paying significant amounts of money to purchase licenses to use that data.

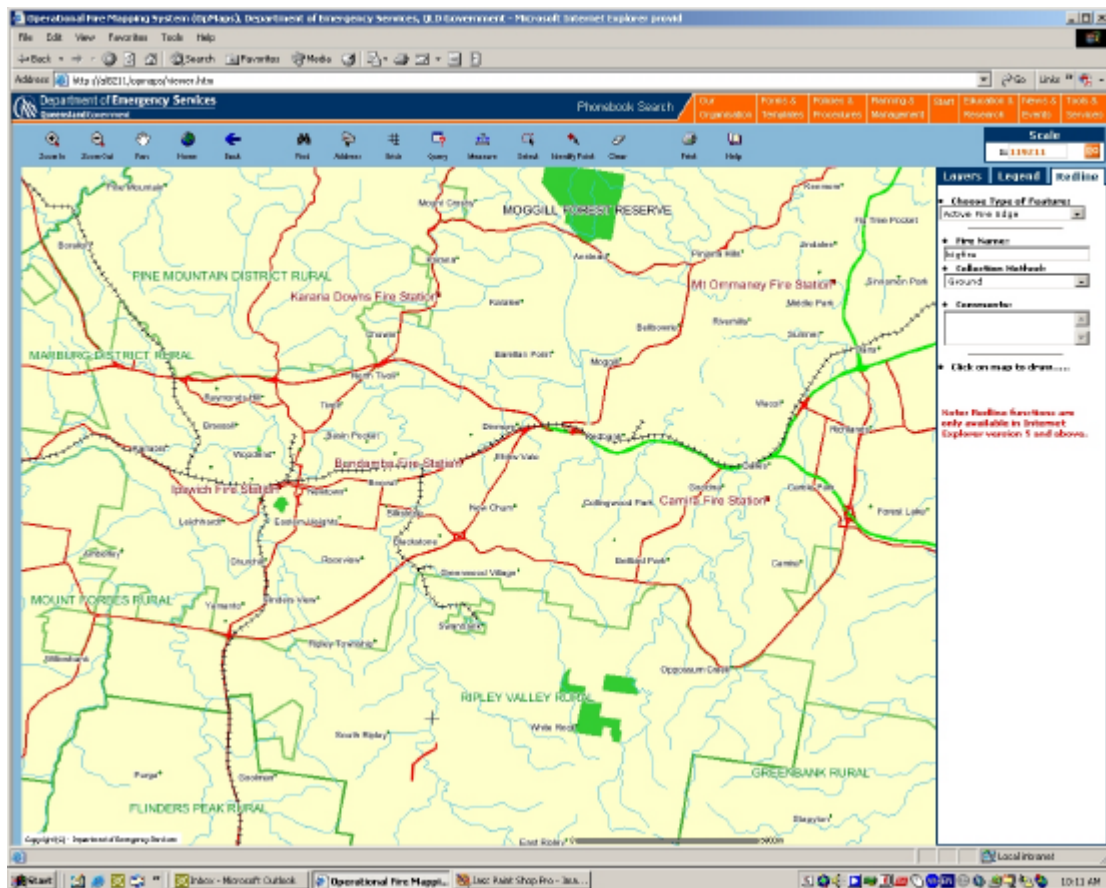
The large states such as Queensland, WA, SA, NT and NSW, with vast areas to cover and a lack of quality mapping in many areas, access to remotely sensed data is becoming more and more crucial. This is either in the form of satellite imagery or aerial photography. The problem facing these jurisdictions is mainly due to the

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<sup>3</sup> GeoScience Australia has an ongoing commitment to mapping Australia at 1:100,000 and 1:250,000 map scales (and smaller) and in providing this data in hardcopy format as well as digital..

prohibitive costs involved in accessing the information. Imagery can be also very useful to the large states for the mapping of ground features etc, due to the poor quality or lack of appropriate data across most of the State.

It is very frustrating to emergency management agencies when Local, State or Federal Governments acquire data for their own use and do not coordinate it's collection or even share knowledge of it's availability.



**Figure 3 – “OPSMAPS” is an internet mapping application developed by the Queensland Department of Emergency Services. It provides a decision support tool in remote locations, produces of strategic and operational maps, and allows for the input of fire data from the field. OPSMAPS presents fire managers with timely information as to the status of the fire extent and the mitigation measures in place to control the incident.**

## 5.2 A National Approach

### 5.2.1 Standards

Standards are very important for the integration and interoperability of information and systems. For example the Bureau of Meteorology spends a significant amount of resources bringing together GIS data from different states because data is held in a variety of projections and formats.

In its submission to the Canberra Inquiry, ASIBA promoted a national approach with a move to greater standardization of data collection and processing. The Victorian Inquiry also recommended that the local bushfire agencies review the standards and protocols for documentation, including mapping, provided to fire line managers as part of their briefing notes, to ensure these are concise and appropriate.

EMSINA agrees that consistency and standardization of GIS systems and products are important. Standardization:

- Minimizes cost of uptake of new information
- Maximizes utility and stability of information products
- Permits more applications to operate under known conditions
- Increases interoperability between GIS applications and data sets
- Enables efficient deployment of skilled GIS operators across state and territory boundaries.

The US Government sets strict interoperability standards for vendors and service providers bidding for Government related contracts and systems. EMSINA encourages Australian Governments to take a similar approach.

EMSINA actively promotes the development of common operating procedures and is working on the development of standard mapping symbologies.

### **5. 3 An All Hazards - All Governments approach**

The emphasis in emergency management practices has undergone a paradigm shift to a broader model of community safety and sustainability. Better information systems are a prerequisite to planning and integral to public awareness, education and warning programs, activities and strategies in ways which will lead to the outcome of desired protective behaviors. One of the key recommendations of the Victorian Inquiry was:

*...that Government acknowledge the importance of spatial information as a key element of planning, operations and program evaluation*

and also that

*... all emergency service agencies, ... give greater priority to information management – especially the collection, maintenance and quality control of base data sets necessary for planning, operations and program evaluation.*

These principles are totally supported by EMSINA. It is vital that all information, not just spatial information is timely, accurate and fit for use.

In NSW, a unit called the Emergency Information Coordination Unit (EICU) has been created as a means of ensuring integrated and coordinated information management on a whole-of- Government basis. There are several equivalent initiatives in other states such as the Geospatial Emergency Information Network (GEIN) in Victoria.

They support an *all hazards approach* initially concentrating on response by emergency management agencies to terrorist attacks. It is a waste of effort preparing for specific emergencies when 90% of spatial information (e.g. roads) is used in multiple hazard environments. The industry should concentrate on a robust flexible

capability that is effective, mobile timely and adaptable. EMSINA strongly supports the EICU, the GEIN and their cohorts in other states.

The issue of national coordination of spatial information industry extends much further than the management of bushfires. Local, State and Federal Government Agencies are involved in emergency management and the sector generically covers many other hazard types such as flood and earthquakes. In particular there is the need to coordinate and manage information across levels and between divisions of government, and across sectoral boundaries to the private sector, especially the water, energy and telecommunications utilities, non-government organisations (NGOs) and the public. There needs to be a pre-established information management regime – effective coordination and management of information systems and resources cannot be achieved in the heat of an emergency response, or in the aftermath.

A good example of the concepts reviewed in this section and the previous is the topic of Rural Road Numbering. A new Australian Standard (AS/NZS 4819:2003) has been completed on a method addressing rural properties in a consistent way based on distance from the beginning of a road. When the new addressing system is applied it does away with the likes of R.M.B.'s (Roadside Mail Boxes) and Lot Numbers. The system significantly enhances the efficiency of emergency dispatch by simplifying local addresses. Many Local and State Governments are reluctant to take on the task of introducing the new standard

Not all parts of the government sector are willing participants in contributing their expertise, intellectual property or data to enhance community safety. For example significant and first rate GIS products, systems and data developed by the Department of Defence remain elusive and unobtainable to the wider emergency management sector whilst local governments for a range of reasons are not easily persuaded to contribute to higher-level programs.

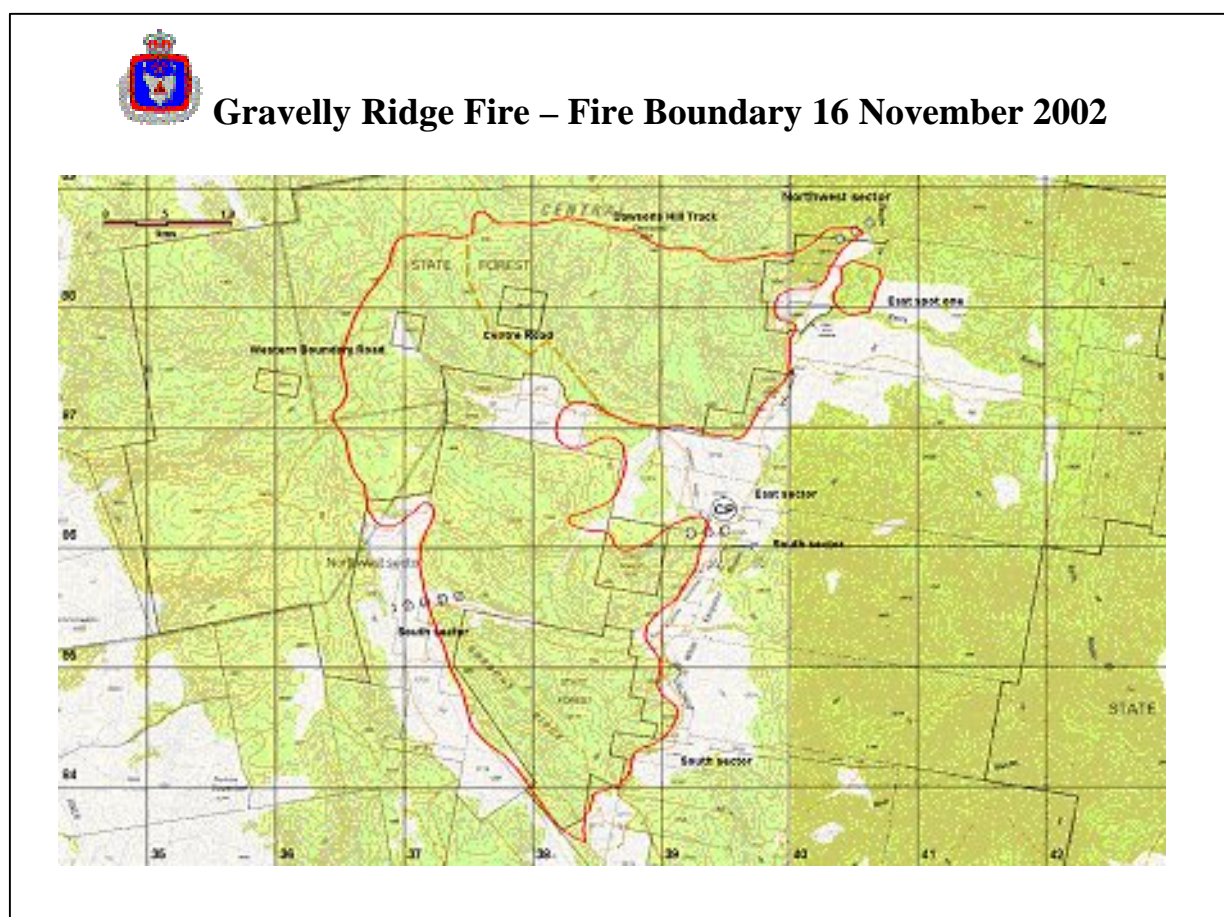
Policy makers, practitioners and products suppliers should all have a stake in community safety and can contribute to the ongoing improvement in the use of GIS.

EMSINA suggests that:

- Emergencies are multi-scale and multi-hazard therefore many jurisdictions and sectors are affected and should be encouraged to participate in national frameworks and initiatives.
- GIS and it's related technologies are here to stay and will only increase in use. The majority of users of GIS such as firefighters will never be exposed to the complexity and inner workings of GIS's and the mapping sciences that underpin them however that same audience will deliver the greatest benefits in the form of sound planning, decision making and incident management. Generic tools and systems that are easily used and understood should be the goal of all emergency management agencies.
- COAG can raise the profile of the spatial information toolbox as a means of enhancing community safety.

EMSINA encourages:

- State GIS user groups to continue to develop interagency contacts and links. The benefit of the sharing of GIS resources has already been seen during recent bushfire seasons with intrastate and interstate personnel participating in GIS teams at bushfires.



**Figure 4 - This map was created by the Tasmanian Fire Service GIS in an area where no paper maps were available.**

## 6. Conclusion

Improvements at local and state levels in the coordination and use of Geographic Information Systems are likely to deliver short-term improvements in information management however true benefits are to be derived from the longer-term strategic improvements. No one agency or state can do this on it's own.

The activities outlined in this submission require commitment at all levels of government to standards, making information accessible by others, by committing to accurate data and by investing in systems and people that can create a safer community through the power of intelligent mapping and Geographic Information Systems.