

Surveying Response to the Victorian Bushfires of February 2009

Eddie CICHOCKI, Australia

Key words: Bushfire recovery, cadastral infrastructure, volunteer surveyors

SUMMARY

'Black Saturday' will be remembered by many as the day Victoria experienced its worst bushfires on record. On that day, Saturday 7 February 2009, temperatures in the mid 40°C combined with strong winds and dry bush from years of drought led to extreme bushfires with tragic consequences. Towns were destroyed, over 2000 properties were burnt and one hundred and seventy-three people lost their lives.

In the aftermath of the fires, the surveying and spatial science community of Australia responded in numerous ways to help fire-affected communities and individuals in the recovery process. The Victorian Bushfires Surveying Taskforce was established to coordinate the offers of help and provide a land surveying response that would benefit the recovery process and maximise the contribution of volunteer surveyors. A project plan was developed which centered on securing surviving survey marks and monuments that would subsequently be used to re-define property boundaries 'lost' in the fires.

The project included the provision of Map Grid of Australia (MGA94) horizontal survey control to the fire-affected areas, the preparation of guidelines for safely surveying in post-bushfire environments, the identification of areas requiring survey marks and monuments to be located and referenced by volunteer fieldwork and the preparation of documents to record the results of the surveys.

This paper discusses the work of the Victorian Bushfires Surveying Taskforce and volunteer surveyors in securing cadastral infrastructure to enable the boundaries of fire-affected properties to be re-defined efficiently and economically at a later date. It also provides an insight into associated matters that need to be considered when providing a survey response to destruction caused by bushfires.

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1. INTRODUCTION

Most parts of Australia are prone to bushfires on a regular basis. Grasses, shrubs and the litter of bark, twigs and leaves in Eucalypt forests become combustible in summer when they dry out following spells of fine, hot weather. In February 2009, following 12 years of drought, the State of Victoria in Australia's south-east was in extreme danger of bushfires. Heatwave conditions in late January, where a period of maximum temperatures in the mid 40°C was experienced, had increased the combustibility of the forest and grass areas statewide. On Saturday 7 February, strong gale-force north-westerly winds hit the state accompanied by temperatures in the mid 40°C and relative humidity below 10 per cent. The winds fanned many fires that ignited or were burning across the state, some of which were to become the most destructive and tragic in Australia's history and have since been referred to as the 'Black Saturday' bushfires.

Figure 1 shows the location and extent of the February 2009 fires in Victoria. The largest and most devastating was the Kilmore East - Murrindindi Complex fire which severely impacted on the towns of Kinglake and Marysville and their surrounding areas.



Figure 1. February 2009 fires shown in red. Source: *2009 Victorian Bushfires Royal Commission – Interim Report.*

Once extinguished in mid-March, the fires had burnt approximately 430,000 hectares of land and tragically claimed the lives of one hundred and seventy-three people. About 3,500 structures were destroyed including 61 businesses, 12 community buildings and over 2000 properties. The devastation of the fires stirred the compassion of many in Australia and throughout the world and initiated numerous responses to assist fire-affected individuals and communities in the recovery process.

2. VICTORIAN BUSHFIRES SURVEYING TASKFORCE

Immediately following Black Saturday, the Office of Surveyor-General Victoria and the professional surveying and spatial science associations in Victoria received numerous offers of assistance for the surveying aspect of the recovery. It was evident from the images in the media and the reports of the ferocity of the fires that much property boundary fencing had been destroyed or damaged and survey work would be necessary to re-define the 'lost' boundaries on the ground. Approximately 120 offers of assistance were received from the surveying and spatial science community throughout Australia, predominately from the private surveying firms practicing in Victoria. 250 individuals had donated services and equipment to the recovery which equated to approximately 5000 hours of work.

The Victorian Bushfires Surveying Taskforce, herein after referred to as "the Taskforce", was established to coordinate the land surveying response to the bushfires. The Taskforce consisted of members from Government, specifically the Department of Sustainability and Environment through the Office of Surveyor-General Victoria and Spatial Information Infrastructure, professional institutions including the Association of Consulting Surveyors Victoria, the Surveying and Spatial Sciences Institute, the Institution of Surveyors Victoria and the Spatial Industries Business Association and academia through RMIT University. The initial step of the Taskforce was to develop a project plan that would be most beneficial to the recovery works and would maximise the contribution of the volunteer surveyors.

The Taskforce decided that due to the works being undertaken in the fire affected areas to remove hazards and clean-up sites, the most appropriate response was to secure the surviving survey marks and monuments located within road reserves. It is these marks that cadastral surveyors use re-define property boundaries and their preservation was seen as critical to ensuring that surveys for the purpose of boundary definition could be performed efficiently and economically, thereby providing benefit to the fire affected communities as they re-built.

2.1 Survey Marks

The re-definition or re-establishment of boundaries in Victoria is generally based on using survey marks, monuments and occupation as evidence to retrace original surveys. When a cadastral survey is performed in Victoria, the surveyor is required to relate the boundaries to survey marks and occupation in the vicinity of the parcel and document the results in an Abstract of Field Records or a Record of Having Re-established a Parcel. These documents

are subsequently registered by the State Government and made available as survey information for future surveys.

The types of survey marks used in Victoria which the Taskforce considered important to locate and preserve in the fire areas fall into three categories – Permanent Marks, Reference Marks and Boundary marks. Permanent Marks are established under the *Survey Co-ordination Act 1958* and are most commonly brass plaques set in concrete at ground level. There are approximately 131,000 registered permanent marks in Victoria of which 75,500 have either accurate horizontal or vertical coordinates (to the nearest 0.001m) or both. It is these marks that form the state's ground mark survey control network. Reference marks are survey marks of a durable nature which are placed in cadastral surveys near property corners and are connected to them by measurement. These marks are typically small sections of iron pipe, iron rod or spikes that are placed just below ground level so as to provide them with some protection. Boundary Marks are the marks placed at property corners to indicate boundaries on the ground. The main form of boundary mark used in Victoria is a durable timber peg which is required to be placed with the top at or just above ground level.

Figure 2 shows examples of permanent marks, reference marks and boundary marks located by surveyors in the fire-affected areas. Once found, the marks were required to be referenced by survey measurement and staked to assist in preserving them during the clean-up works. The colour blue was adopted by the Taskforce as the standard colour for the paint and flagging tape used to indicate the marks found.



Figure 2. (L-R) Permanent mark, reference mark and timber peg found and staked by volunteer surveyors.

Reports from the volunteer surveyors were that permanent marks and reference marks did not melt during the fires and remained generally intact and stable. The timber pegs marking property corners also remained intact although many were found burnt and in poor condition. In areas where there was little or no survey marks, volunteers were requested to locate the burnt remains of fencing as it provided the best evidence of where the boundaries were. It was quite common in the fire areas to find all that remained of a rural fence was the strands of wire on the ground and the holes where the posts used to be.

2.2 Project Plan

In order to effectively manage the volunteer survey work, a project plan was developed by the Taskforce outlining the key steps to be undertaken to secure the surviving survey marks and monuments. The first step was to establish a single volunteer register to centralise the offers of help and assist with the allocation of resources to specific areas. Next was the task of providing accurate horizontal survey control in the fire areas so that the volunteer survey work could related to the one datum, namely Map Grid of Australia 1994 (MGA94). This control needed to be established prior to the volunteer work and was to take the form of coordinated permanent marks and GNSS reference stations to cater for traditional and GNSS survey measurement technologies. Survey Guidelines were then to be developed to provide volunteers with instructions on the tasks to be performed and how to document the results of the surveys. This was to be followed by the identification of areas requiring survey marks and monuments to be recovered and referenced. Post-fire aerial photography and field inspections combined with an assessment of the cadastre were to be used for this purpose. Once the areas had been identified, the relevant survey information was to be compiled and provided to volunteers to enable them to make an assessment and identify the critical survey marks to be located and preserved prior to performing the fieldwork.

3. MAP GRID OF AUSTRALIA 1994 SURVEY CONTROL

The Map Grid of Australia 1994 (MGA94) is the system of rectangular coordinates adopted in Australia to express positions in terms of Eastings and Northings and is based on a Universal Transverse Mercator projection of geographical coordinates on the Geocentric Datum of Australia, 1994. In Victoria, MGA94 survey control is provided by a network of coordinated permanent marks and GNSS reference stations maintained by the Department of Sustainability and Environment. Following the fires, an assessment was made of the available MGA94 control in the Kinglake and Marysville regions to determine whether it was sufficient for the expected survey work of the volunteer surveyors. Staff from the Office of Surveyor-General Victoria and Spatial Information Infrastructure entered the fire-affected areas shortly after Black Saturday to perform the assessment and strengthen or establish the control as required. . This was done at a time when a Coroner's Order restricting access was still in place and required co-operation with the Victoria Police and the Army so as not impede their search operations.

3.1 Coordinated Permanent Mark Networks

Figure 3 shows plots of the ground mark control networks in the vicinities of Kinglake and Marysville. Both networks were established in the 1970's by traversing with theodolite and EDM as part of the state's Survey Co-ordination Project. In the Kinglake region, due to the topography and vegetation, the traversing was restricted predominately to the major roads and the poor geometry resulted in some of the marks having positional uncertainties of ± 0.3 metres. 50 of the 65 coordinated permanent marks in this region were recovered and further marks were established and additional GNSS vectors observed to densify and strengthen the network. This improved the positional uncertainties to better than 0.08 metres.

In Marysville, as the network was more compact and had been established with better geometry, the positional uncertainties of the permanent marks were better than 0.05 metres with the majority in the order of ± 0.02 metres. 44 out of 61 coordinated permanent marks were found surviving and subsequently deemed to be adequate as control for the township.

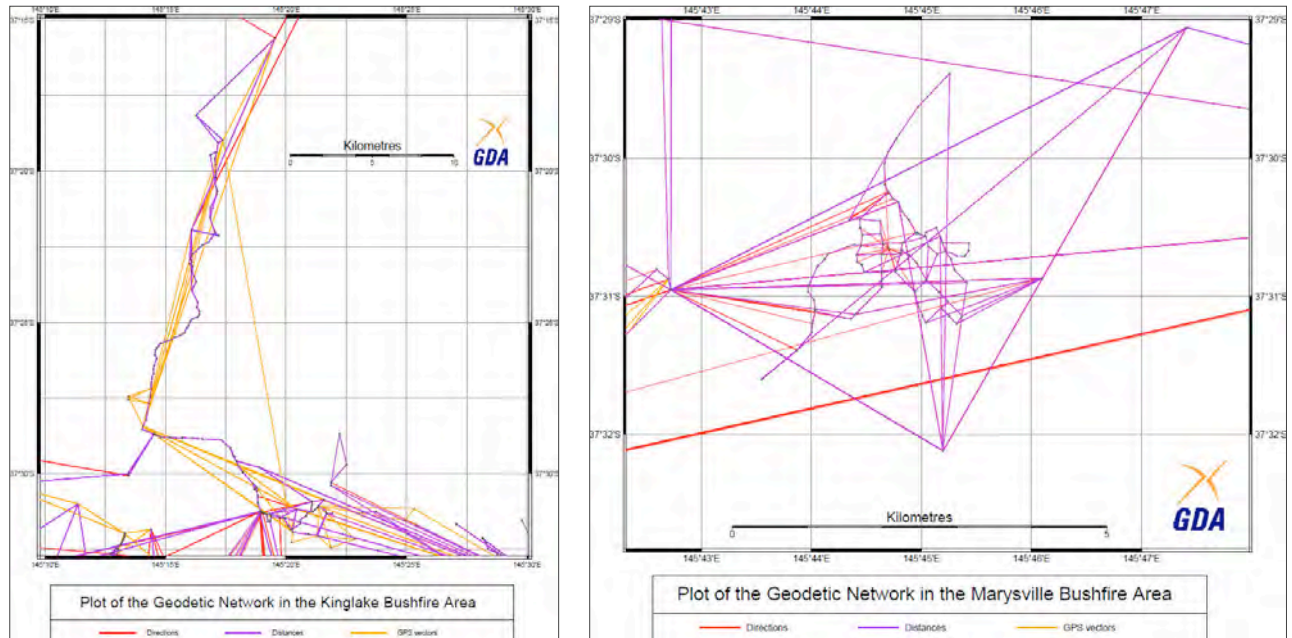


Figure 3. Permanent mark control networks at Kinglake and Marysville.

New coordinated permanent marks were also established in other fire-affected areas including Granton, Traralgon South, Callignee and Steels Creek to enable volunteer fieldwork to be brought onto the MGA94 datum.

3.2 GNSS Reference Stations

Temporary GNSS reference stations were established at Kinglake and Buxton to provide position solutions to the various GNSS users, including volunteer surveyors, working in the Kinglake and Marysville regions. The hardware for these stations was donated by two major survey equipment suppliers in Melbourne and installed by an expert team of volunteers. The reference stations were incorporated into Victoria's Continuously Operating Reference Station network *GPSnet*TM to provide Networked Real-Time Kinematic position solution coverage over the fire-affected areas.

4. SURVEY GUIDELINES

Due to the uniqueness of the work and the environment in which it was going to be conducted, detailed survey guidelines were prepared to provide, amongst other things, instructions on the tasks to be performed and how to document the results of the surveys. The guidelines included sections on the site clearance and clean-up activities which were being undertaken in the fire areas and how to deal with people directly affected by the fires. The Taskforce expected that there would be mixed emotions within the communities about the recovery works and that volunteer surveyors would have to be prepared to deal with residents reacting in different ways. To assist in this matter, identification in the form of an ID Sticker was produced for volunteers to display when performing their duties and a Resident Information Sheet was prepared that could be handed out to describe the work being undertaken by the volunteer surveyors and provide answers to some frequently asked survey-related questions.

4.1 Occupational Health and Safety

A significant part of the guidelines was dedicated to the issue of Occupational Health and Safety (OH&S) for surveyors working in fire-affected areas. A Job Safety Analysis (JSA) was developed highlighting potential risks, such as falling tree branches and exposure to contaminated materials, and the control measures to eliminate or minimise those risks. Details of the Personal Protective Equipment (PPE) to be used on site were provided and divided into two categories – mandatory items and those that may be required depending on the conditions found on site. The volunteer surveyors were expected to provide their own mandatory PPE whilst the additional items such as overalls, heavy duty gloves, protective glasses and P2 facemasks were provided by the Taskforce.

A Volunteer Safety Kit was developed and included a Code of Conduct, a Site Safety Survey to be completed by each team every day, an Acknowledgement Form to be completed by each volunteer prior to working on the project and the relevant emergency information and contact details. Volunteers were provided with their kits before attending the fire areas and were required to familiarise themselves with the contents prior to starting their fieldwork.

Staff from the Office of Surveyor-General Victoria were trained in the OH&S management of volunteers so that they could act as area managers when the volunteer fieldwork was being undertaken. Their duty was to brief the volunteers at the beginning of each day prior to the commencement of any work and to run through the details of the Volunteer Safety Kit and any specific hazards or operational circumstances that may have arisen which could affect the safety of the volunteers. They also had to ensure that volunteers signed-in and signed-out at the beginning and end of every day and were to remain on-site during the fieldwork as the first point of contact for any issues or emergencies.

4.2 Insurance

Volunteers were not required to obtain insurance cover for the survey activities they were to undertake in the fire areas. It was considered that as the work was being conducted on behalf of Government under the auspices of the Taskforce, the legal liability for an incident occurring would be borne by the Taskforce as the supervising authority. Initially it was thought that a whole-of-government solution would be provided to cover the wide range of volunteer activities being undertaken in the fire areas, however that did not eventuate and consequently the insurance cover was arranged for the Taskforce by the Department of Sustainability and Environment. The insurance cover was for a period of 7 months and provided Personal Accident cover with weekly benefits up to \$3000 and a death benefit of \$500,000 and professional indemnity cover of up to \$20 million. No cover was provided for any loss or damage to the personal property of the volunteers.

The issue of insurance combined with the Coroner's Order restricting access to the areas meant that volunteers could not be deployed into the field at Kinglake and Marysville until after 1 April 2009, almost two months after Black Saturday.

5. IDENTIFICATION OF AREAS

Areas for the recovery of survey marks and monuments were identified using post-fire aerial photography overlaid with Victoria's Digital Cadastral Map Base, *Vicmap Property*. The selection of areas involved inspecting the photography to identify localities where there was a concentration of damage and then using *Vicmap Property* to determine how the cadastre was created in those areas so that relevant subdivisions and surveys could be identified. The areas tended to be in the more populated regions such as in townships or semi-rural districts and their sizes were determined based on the extent of existing subdivisions and an estimate of 1 to 2 days fieldwork for the volunteers assigned to them. Field inspections were also conducted to fine tune the selected areas and identify further areas where there was significant damage to fencing along property boundaries.

The Kinglake region was the first to be prepared for volunteer fieldwork as the Police and Army were to conclude their searches in that area prior to moving onto the other fire-affected localities where deaths had occurred. 30 areas were identified by the Taskforce in the region which included the localities of Kinglake, Kinglake Central, Pheasant Creek, Kinglake West, Hazeldene, Flowerdale, Castella, Steels Creek, Strathewen and Humevale. Figure 4 shows the three areas PC1, PC2 and PC3 the Taskforce identified at Pheasant Creek. One of the areas, namely PC3, was selected to cover the entire subdivided length of Pine Ridge Road which before the fires was a picturesque residential street adjacent to the Kinglake National Park. The aerial photo shows the northern end of Pine Ridge Road approximately one month after the fires. As is evident from the photo, there was much destruction in this area and from accounts the bushfire struck very quickly from two directions trapping many residents. All 30 houses in the street were destroyed and 24 people perished in this one location.



Figure 4. Taskforce areas at Pheasant Creek. PC3, shown circled in red, covered Pine Ridge Road (pictured).

5.1 Regional Areas

Whilst the Taskforce was identifying areas at Kinglake and Marysville, local survey firms in regional Victoria took the initiative and identified areas close to them that had been impacted by the fires and would benefit from a similar program of survey mark recovery and preservation. Areas were identified in the vicinities of regional townships Horsham, Bendigo, Boolarra, Traralgon South and Callignee and the survey firms devised their own programs to perform the recovery fieldwork. Although not directly under the control of the Taskforce, the regional survey firms were provided support in the form of the provision of the relevant survey information by the Taskforce and were required to perform their duties in accordance with the Survey Guidelines.

5.2 Marysville

Following the conclusion of the volunteer fieldwork in the Kinglake Region, the Taskforce anticipated that similar fieldwork would be undertaken in the township of Marysville which had also suffered much destruction in the fires. However, following a field inspection and detailed analysis of the cadastre in and around Marysville, it was determined that survey mark recovery and referencing was unnecessary due to the dense and robust network of surviving permanent marks in the township and the links of existing title surveys to those marks.

Unlike the Kinglake region and the regional areas affected by the fires, Marysville is covered by what is known as a Proclaimed Survey Area (PSA). Proclaimed Survey Areas were created under the authority of the *Survey Co-ordination Act 1958* and were envisaged as a staged progression towards statewide co-ordination of surveys. An area was proclaimed as a PSA once a dense network of permanent marks had been established and a control survey conducted to provide each mark with survey-accurate grid co-ordinates.

Regulations under the *Survey Co-ordination Act 1958* require all surveys in a Proclaimed Survey Area to connect to the network of co-ordinated permanent marks. The legacy of the PSA concept in Marysville was that even if all the marks and monuments from a cadastral survey were destroyed, the property boundaries could still be accurately re-defined from the permanent mark network via the measured connections observed in that survey.

6. VOLUNTEER FIELDWORK

At the conclusion of the identification of areas requiring survey marks and monuments to be recovered, the Taskforce proceeded to allocate the areas to survey firms who were on the volunteer register. The relevant survey information was collated and supplied to the volunteers who were required to peruse it prior to commencing their field duties so as to identify the marks and monuments considered important to recover and preserve for future surveys.

Following resolution of the issue of insurance for volunteers and the lifting of the Coroner's Order, the fieldwork in the Kinglake region commenced on the 3 April 2009 and continued for two months concluding on 4 June 2009. Volunteers worked sporadically during this period with much of the fieldwork performed on the weekends so as not to impact significantly on their normal businesses. An on-site office was established by the Taskforce in a re-locatable building adjacent to the Kinglake Recovery Centre to manage the volunteers. The office was manned by at least one area manager on each day of the volunteer fieldwork and it was here that volunteers had to report at the start of the day to be briefed on safety issues and return to at the end of the day to sign-off.

Figure 6 is a collection of photos of the volunteer surveyors at work in and around Kinglake. A combination of electronic angle and distance measurements via Total Stations and position measurements using single rover GNSS receivers were used by the volunteers for determining the positions of the survey marks found. Regardless of the equipment used, the requirement was for all the surveys to be related to the one datum, namely the Map Grid of Australia 1994. This was achieved via connection to the coordinated permanent mark network or the GNSS reference stations that had been established earlier to cover the work areas.

A total of 30 survey firms and 81 individuals performed the volunteer fieldwork in the Kinglake region over the two month period from April to June 2009. A great deal of co-operation was displayed amongst the volunteers, particularly those who were working in adjacent areas who were more than willing to assist each other with field measurements and share information. The volunteers carried out their field duties professionally and in all instances adhered to the safety and work instructions provided by the Taskforce. They reported a very good success rate for the survey marks and monuments searched for and from an Occupational Health and Safety perspective no injuries or near misses occurred.



Figure 6. Volunteer Surveyors at work in the Kinglake Region

6.1 Regional Fieldwork

A similar high success rate for the recovery of critical cadastral survey infrastructure was also reported in all the regional areas. In Bendigo, the volunteer survey work of the four local surveying firms developed into another project to re-mark the boundaries of the 75 properties affected by the fires in that area. The Rotary Club of Eaglehawk in-conjunction with the Bendigo Bank and local businesses had generated the funds for the property boundary surveys to be performed. In an effort to maximise the benefits of the earlier survey mark recovery work and to capitalise on the specific knowledge gathered by each firm, the property boundary surveys were allocated by Rotary to each firm according to the areas they had worked in initially. The surveying firms had agreed amongst themselves to donate part of their time to project so that a standard set fee for the provision of their professional services could be applied to the property surveys.

6.2 Other Volunteer Services

Whilst the volunteer fieldwork for the Taskforce was being performed in Kinglake and the regional areas, other volunteer survey services were being provided to residents affected by the fires. A number of private survey firms had of their own accord offered to

undertake property boundary surveys either pro-bono or at a reduced fee. The Taskforce also established a professional survey advice service to assist residents in determining whether or not they required a survey of their property boundaries to be performed. The service was provided by professional surveyors selected from the volunteer register at both the on-site Taskforce office in Kinglake and over the telephone. As could be expected, each enquiry was different but the general advice provided to residents was that if the remains of fencing existed and they and their neighbours had no concerns with its position, then the boundary could be re-fenced along the same line without the need for a survey.

7. SURVEY DOCUMENTATION

Details of the documentation required to be prepared by volunteers to record the result of their surveys were provided in the Survey Guidelines prepared by the Taskforce. The guidelines directed that the results be presented in a standard format similar to that of a Record of Having Re-established a Parcel as per Regulation 16 and Schedule 4 of the *Surveying (Cadastral Surveys) Regulations 2005*. Cadastral surveyors in Victoria are accustomed to this format as they are required to prepare Records of Having Re-established a Parcel or “RE Plans” when they undertake a re-establishment of part or whole of a land parcel.

The RE Plans prepared for the bushfire recovery work were required to contain the heading “2009 Bushfire Format” and a diagram showing the survey marks and monuments located and the measurements observed/derived between them. Unlike a normal RE Plan, the exact relationship of the survey marks and monuments with boundaries and alignments was not required to be determined and shown on the plan, however some volunteer surveyors chose to do so thereby fixing their area for future property surveys.

As all the surveys were required to connect to the Map Grid of Australia 1994 datum, coordinates were also to be provided for the marks and monuments located in a table on a separate sheet of the RE Plan. The purpose of coordinating the marks found was that if they were destroyed during the clean-up works, their positions could still be used as evidence in the process of boundary re-definition. Volunteers were also encouraged to take digital photographs of the survey marks found to assist other surveyors in finding them when they were required to be used for a property survey.

The completed 2009 Bushfire Format Records of Having Re-established a Parcel have been registered by the Surveyor-General under Regulation 16 of the *Surveying (Cadastral Surveys) Regulations 2005* and are considered legal documents that can be used in boundary re-definition surveys. Figure 7 is an example of a registered 2009 Bushfire Format RE Plan. It shows the types of marks and monuments placed or located during the recovery surveys including Permanent Marks (PMs), Primary Cadastral Marks (PCMs) and burnt pegs and posts.

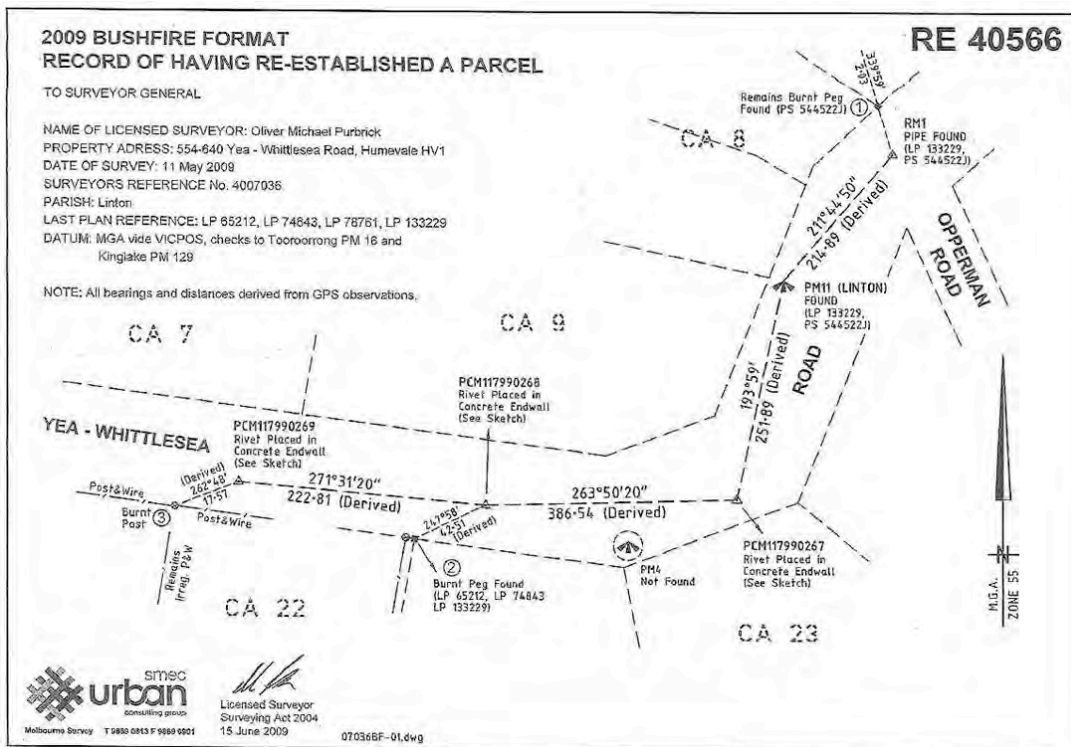


Figure 7. 2009 Bushfire Format RE Plan prepared for Taskforce area Humevale HV1 and registered as RE40566.

8. COMMUNICATION

Communication through all stages of the survey mark recovery project was seen as critical to a successful outcome. In the early stages of the project, regular update bulletins were prepared by the Taskforce and included in the professional surveying and spatial science associations' publications in order to provide updates to those who had volunteered their services. In addition to providing information on the project, the purpose of the bulletins was to keep volunteers motivated and enthusiastic knowing that it might be some time before they could actually be deployed in the bushfire areas. The bulletins were also posted on a website created specifically for the Victorian Bushfires Surveying Taskforce. Other information for the volunteers included on the website was the Survey Guidelines for the fieldwork and the updated sketch plans of the surviving permanent marks showing their newly adjusted Map Grid of Australia 1994 coordinates.

A section providing information for residents was also included on the website and contained the Resident Information Sheet prepared for volunteers to hand out describing the work of the Taskforce and providing answers to questions such as "How do I find out where my property boundaries are?", "Who can survey my property boundaries?" and "Where do I find a licensed surveyor?". A licensed surveyor is a person who is legally entitled to perform cadastral surveys in Victoria and a list of survey firms with at least one licensed surveyor as a

staff member was added to the website to enable residents to arrange a survey to be performed of their property boundaries on a fee-for-service basis.

The Taskforce website was also cross-linked to the numerous community websites established after the bushfires to provide residents with advice on the services available to assist in their recovery.

9. CONCLUSION

The Victorian Bushfires Surveying Taskforce through the work of volunteer surveyors in the State of Victoria has provided significant benefit to those communities affected by the February 2009 fires. By locating, referencing and preserving critical cadastral survey marks and monuments, property boundary surveys that are now being effected as part of the recovery and re-building process are being performed more efficiently and economically. Residents have also been provided with access to professional survey services so that they can make informed decisions about property surveys, which is usually one of the first tasks they need to consider when they decide to re-build.

There are some lessons that have been learnt from this project that could be acted upon in preparation for a response to a similar tragedy. The first is associated with the issue of insurance for volunteers and having the details of a policy in place so that it can be activated rapidly if required. This was an obstacle for the Taskforce in this instance and delayed the deployment of volunteers into the field. The ideal situation would be if Government had a general policy in place for all volunteers responding to an emergency, regardless of the type of work they were to perform. Secondly, the situation in Marysville where the dense and robust network of coordinated permanent marks and the requirement for all cadastral surveys to connect to these marks meant that volunteer fieldwork was not necessary to preserve the other survey marks and monuments connected to in those surveys. The establishment of Map Grid of Australia 1994 survey control in towns or areas identified as having a high fire threat and mandating cadastral surveys to connect to that control would be one pro-active measure that could be implemented to assist those towns in disaster recovery if required. Another pro-active measure would be to have a spatially accurate digital cadastral map base that could provide benefits a number of users including emergency services, utility companies and Councils responding to disasters such as bushfires.

10. ACKNOWLEDGEMENTS

I would like to thank the individuals and firms who volunteered their services, regardless of whether they were called upon, to assist the fire-affected communities in the survey component of the recovery process. The volunteers who performed the fieldwork did so with enthusiasm and commitment and I would like to thank them for the camaraderie and co-operation they displayed. I would also like to thank the members of the Victorian Bushfires Surveying Taskforce for their guidance, counsel and support on all the aspects of the project. And finally, I would like to extend my gratitude to my colleagues at the Office of Surveyor-General Victoria, Spatial Information Infrastructure and Land Victoria who generously gave

their time and skills to perform the necessary support functions such as providing survey control, managing the volunteers and preparing and disseminating the relevant information. Their role was critical to the success of the volunteer fieldwork and the consequential benefits that flowed onto the community.

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BIOGRAPHICAL NOTES

Eddie Cichocki is a Senior Surveyor with the Office of Surveyor General Victoria, a position he has held for the past eight years. Following graduation from the University of Melbourne in 1984, he worked for two years as a lecturer in surveying at the Royal Melbourne Institute of Technology (RMIT) University. After a brief stint in private practice with a small surveying firm, he joined the public sector in 1987 and qualified as a licensed cadastral surveyor in 1991. His work in the public sector has included performing geodetic network observations and adjustments, providing survey equipment calibration services to industry and monitoring the standard of cadastral surveys through a survey audit program. In addition to the auditing of surveys, his current duties include providing advice and survey services to government agencies on land dealings and developing policy for cadastral surveys in Victoria. He is member of the Institution of Surveyors, Victoria and in February 2009 accepted the position of Leader of the Victorian Bushfires Surveying Taskforce.

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Victorian Bushfires Surveying Taskforce

Surveying Response to the Victorian Bushfires of February 2009




XXIV FIG Congress 2010
Sydney, Australia, 11-16 April 2010

Presented by:
Eddie Cichocki
Australia

Introduction

- ❖ The State of Victoria is situated in the south-east corner of the Australian mainland and has a variety of vegetation that ranges from open grasslands through to tall eucalypt forests



Introduction

- ❖ In February 2009, following 12 years of drought and a period of heatwave conditions in late January, Victoria was in extreme danger of bushfires



Black Saturday

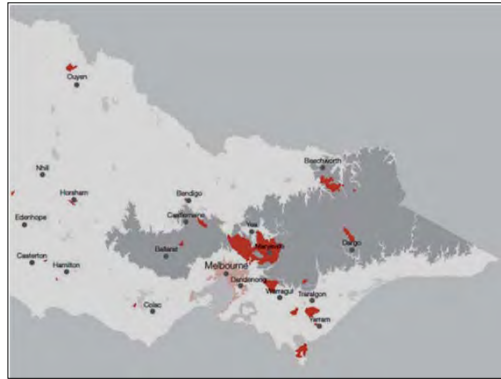
- ❖ On Saturday 7 February 2009, strong gale-force north-westerly winds hit the state accompanied by temperatures in the mid 40°C and relative humidity below 10 per cent
- ❖ The winds fanned many fires that ignited or were burning across the state, which were to become the most destructive and tragic in Australia's history and have since been referred to as the 'Black Saturday' bushfires





February 2009 Fires

- ❖ Once extinguished, the fires had:
 - ❖ Burnt approximately 430,000 hectares of land
 - ❖ Destroyed about 3500 structures
 - ❖ Destroyed over 2000 properties
 - ❖ Claimed the lives of 173 people



Victorian Bushfires Surveying Taskforce

- ❖ Over 120 offers of volunteer work were received from the surveying and spatial science community throughout Victoria and Australia – 65 firms/250 individuals donating services and equipment
- ❖ The Victorian Bushfires Surveying Taskforce (VBST) was established to coordinate the land surveying response to the bushfires
- ❖ Taskforce membership consisted of representatives from Government (DSE), professional industry bodies (ACSV, SSSI, ISV and SIBA) and academia (RMIT)
- ❖ Initial step was to develop a project plan that would be most beneficial to the recovery works and would make best use of the volunteer offers
- ❖ Decided to concentrate on the recovery and referencing of surviving survey marks and monuments





Survey Marks

- ❖ The re-definition or re-establishment of property boundaries in Victoria is generally based on using survey marks, monuments and occupation as evidence to retrace original surveys
- ❖ The types of survey marks considered important to locate and preserve in the fire areas were:
 - ❖ Permanent Marks
 - ❖ Reference Marks
 - ❖ Boundary Marks
 - ❖ Remains of fencing



Permanent Marks





Reference Marks



Boundary Marks





Project Plan

- ❖ Establish a single volunteer register
- ❖ Provide Map Grid of Australia 1994 (MGA94) Survey Control
 - ❖ Network of coordinated permanent marks
 - ❖ GNSS reference stations
- ❖ Prepare Survey Guidelines
- ❖ Identify areas requiring survey marks and monuments to be recovered and referenced
- ❖ Collate survey information and allocate areas to volunteers



Map Grid of Australia 1994 (MGA94) Survey Control

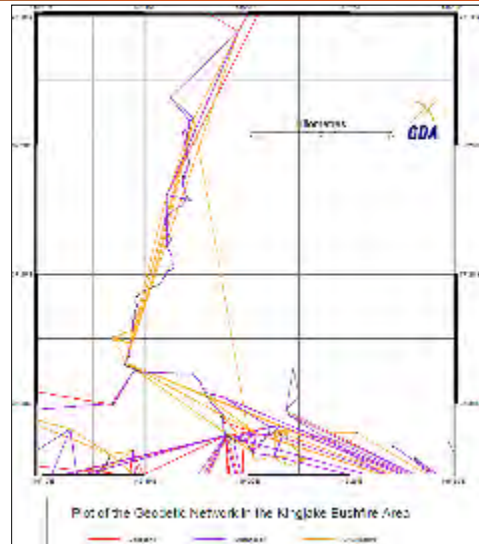
- ❖ System of rectangular coordinates based on a UTM projection of geographical coordinates on the Geocentric Datum of Australia 1994
- ❖ In Victoria, MGA94 survey control is provided by a network of coordinated permanent marks and GNSS reference stations maintained by the Department of Sustainability and Environment
- ❖ Following the fires, the MGA94 survey control was assessed in the Kinglake and Marysville regions to ensure it was sufficient for volunteer surveyors and other users





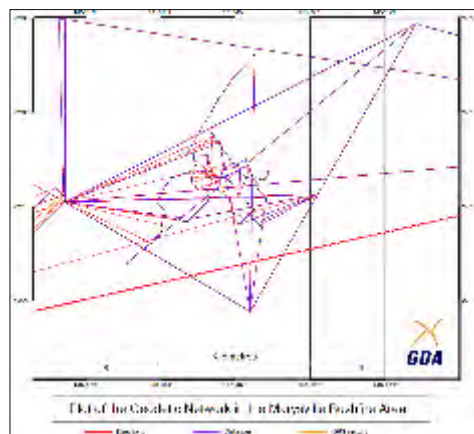
Kinglake Network

- ❖ Maximum Error Ellipses in the order of $\pm 0.3\text{m}$
- ❖ 50 permanent marks recovered
- ❖ 15 Not Found/Destroyed
- ❖ Further permanent marks established and additional GPS measurements observed to densify and strengthen the network
- ❖ Uncertainties improved to better than 0.08m



Marysville Network

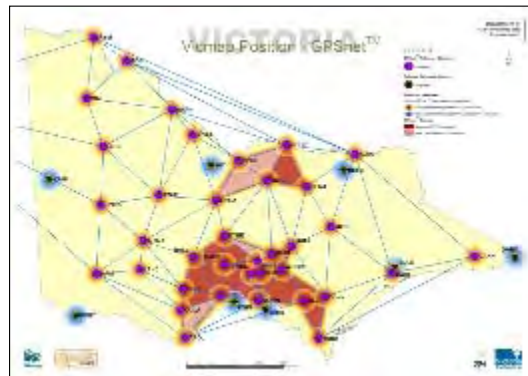
- ❖ Maximum Error Ellipse of 0.05m
- ❖ Majority of Error Ellipses in the order of $\pm 0.02\text{m}$
- ❖ 44 out of 61 coordinated permanent marks found surviving
- ❖ No further work necessary to strengthen or densify the network





GNSS Reference Stations

- ❖ Two temporary GNSS reference stations established at Kinglake and Buxton
- ❖ Hardware donated and installed by Ultimate Positioning and C.R. Kennedy
- ❖ Incorporated into *GPSnet*™ to provide networked real-time kinematic position solutions



Survey Guidelines

- ❖ Guidelines prepared to provide instructions on the tasks to be performed and how to document the results. Included sections on:
 - ❖ Site clearance and clean-up activities
 - ❖ Dealing with people affected by the fires
 - ❖ Volunteer identification
 - ❖ Resident Information Sheet
 - ❖ Occupational Health & Safety Issues
 - ❖ Job Safety Analysis
 - ❖ Volunteer Safety Kit
 - ❖ Area Managers
- ❖ Insurance for volunteers






Identification of Areas

- ❖ Areas were identified using post-fire aerial photography overlaid with Victoria's Digital Cadastral Map Base, *Vicmap Property*
- ❖ Selection of areas based on a concentration of damage, particularly to fencing along property boundaries
- ❖ Areas tended to be in the more populated regions and were determined based on:
 - ❖ The extent of existing subdivisions of land
 - ❖ An estimate of 1 – 2 days fieldwork for each area
 - ❖ Field inspections to provide confirmation
- ❖ Kinglake Region was the first to be prepared with 30 areas identified in the localities of:
 - ❖ Kinglake, Kinglake Central, Pheasant Creek, Kinglake West, Hazeldene, Flowerdale, Castella, Steels Creek, Strathewen and Humevale






VBST Areas Pheasant Creek PC1, PC2 & PC3






Pine Ridge Road, Pheasant Creek



Regional Areas and Marysville

- ❖ In regional areas of Victoria, local survey firms performed their own reconnaissance and identified areas close to them that had been impacted by the fires
 - ❖ Areas identified in the vicinities of Horsham, Bendigo, Boolarra, Traralgon South and Callignee
 - ❖ Support provided by the VBST
- ❖ In Marysville, following field inspections and a detailed analysis of the cadastre, it was determined that a program of survey mark recovery and referencing was unnecessary
 - ❖ Legacy of the 'Proclaimed Survey Area' concept





Volunteer Fieldwork



- ❖ Areas allocated to survey firms and relevant information collated and supplied to volunteers for perusal prior to commencing fieldwork



Volunteer Fieldwork



- ❖ Fieldwork commenced in the Kinglake region on 3 April 2009 and concluded on 4 June 2009





Volunteer Fieldwork



- ❖ Volunteers managed from an on-site office established by the VBST in a re-locatable building at Kinglake



Volunteer Fieldwork



- ❖ 30 survey firms and 81 individuals performed the volunteer survey work in the Kinglake region





Volunteer Fieldwork



- ❖ Very good success rate for the survey marks and monuments searched for was reported
- ❖ Safe work practices – no injuries or near misses occurred



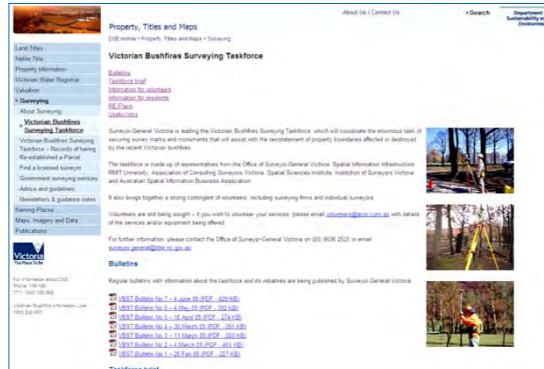
Regional and other Volunteer Services

- ❖ A similar high success rate for the recovery of survey marks and monuments was reported in all regional areas
- ❖ In Bendigo, the volunteer survey work developed into another project where funding was made available to re-mark the boundaries of the 75 fire-affected properties in that area
- ❖ Other volunteer services provided included:
 - ❖ Private survey firms undertaking property surveys either free of charge or at a reduced fee
 - ❖ Professional survey advice service established by the Taskforce
 - ❖ At its on-site office in Kinglake
 - ❖ Over the phone



Communication

- ❖ Regular update bulletins
- ❖ Victorian Bushfires Surveying Taskforce website at:
 - www.dse.vic.gov.au/vbst
- ❖ Volunteer Information:
 - ❖ Survey Guidelines
 - ❖ Updated survey control information
- ❖ Resident Information:
 - ❖ Information Sheet
 - ❖ Advice on how to find a land surveyor
 - ❖ Links to regional community websites



Conclusion

- ❖ The work of the volunteer surveyors has enabled property boundary surveys for recovery and re-building after the fires to be performed more efficiently and economically
- ❖ Lessons learnt:
 - ❖ Having insurance available for volunteers when required
 - ❖ Legacy of the 'Proclaimed Survey Area' concept – establishment of coordinated permanent mark networks in high fire threat areas and mandating cadastral surveys to connect to them
 - ❖ Spatially accurate Digital Cadastral Map Base





Thank you

