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New Zealand Vegetation Fire Database Summary and Initial Data Quality Findings

Tonja Opperman
Wildfire Scientist

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EXECUTIVE SUMMARY

One of the Rural Fire Research Programme's research tasks is analysing vegetation fire occurrence in relation to fuels, weather, and topography. Quality data can help predict fire occurrence and behaviour, pre-position suppression resources, develop fire prevention programmes, and prioritize fuel treatments. This report summarizes New Zealand vegetation fire data and provides initial data quality findings. Information about the New Zealand (NZ) fire reporting system and available statistics was primarily gained through interviews with local and national fire managers and staff.

Understanding possible data locations is facilitated by a rural firefighting organization overview. Rural fire management agencies have several systems in place for getting fire details from incidents to archived reports, and consistent vegetation fire data fields are lacking. There are also inconsistencies among the types of data collected and reporting protocols.

Analyzing wildfire risk in terms of environmental factors requires information on when, where, and how individual fires occur. The NZ Fire Service designed the Station Management System (SMS) for recording all responses, including vegetation fires. However, SMS vegetation fire data quality is suspect because of overlapping data codes and incorrect data entry. Two datasets are worthy of further analysis. DOC probably has the most consistent record of vegetation fire data for individual fires and could be studied for relationships between fire occurrence and environmental factors. Rural Fire Fighting Fund claims may be useful for analyzing large wildfire occurrence and environmental factors. The lack of quality wildfire occurrence data highlights a serious fire management issue deserving urgent attention.

Possible solutions are: revising fire cause categories, determining the level of rural fire SMS reporting, developing standardized paper fire reporting forms, creating a pocket reference to estimate area burnt, ensuring future SMS and weather data links, providing useful vegetation fire analyses to fire managers, and determining needs to record wildfire economic impacts and costs. Resolving these issues will help create a fire occurrence database to support new decision-making tools that require statistical fire information.

This report represents only the first step in understanding the data elements and procedures required to manage a useful wildfire statistics database for New Zealand. Undoubtedly, feedback from fire managers is critical to further refine these initial findings and determine a course of action over the next several months.

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Acronyms Used in this Report

DOC—Department of Conservation
NRFA—National Rural Fire Authority
NZDF—New Zealand Defence Force
NZFDRS—New Zealand Fire Danger Rating System
NZFOA—New Zealand Forest Owners Association
NZFS—New Zealand Fire Service
PRFO—Principal Rural Fire Officer
RFA—Rural Fire Authority
RFD—Rural Fire District
RFFF—Rural Fire Fighting Fund
SMS—Station Management System
TA—Territorial Authority

INTRODUCTION

The threat of unwanted fires in New Zealand is expected to grow as agricultural lands are retired, the rural-urban interface expands, and climate warms, plus there is an increasing fire management emphasis on native biota protection. Statistical fire occurrence data, which includes when, where how and what type of fires occur, can aid fire management activities. Quality data can be used to predict future fire occurrence and behaviour, determine potential tactics and strategies, pre-position suppression resources in areas of need, develop targeted prevention programmes, and prioritize fuel treatments. These items can all play an important role in improving firefighter and public safety. Summarizing available data and improving data protocols ensures reliable data are available for future analysis and decision-making.

The Rural Fire Research Programme is funded by the Foundation for Research, Science, and Technology (FRST) and the rural fire sector. One of the Programme's research tasks is analysing vegetation fire occurrence, causes, and impacts in relation to fuels, weather, and topographic factors contributing to wildfire risk. This report is the first step in that effort, summarizing available New Zealand vegetation fire data, with specific regard to vegetation fire occurrence. An analysis of these data in conjunction with the New Zealand Fire Danger Rating System (NZFDRS) is proposed in future project phases to identify relationships between fire occurrence and environmental factors. This type of analysis can provide geographically relevant decision-making tools for determining fire danger and potential fire behaviour in specific vegetation types. The objective of this report is to summarize existing New Zealand vegetation fire data and determine if current data collection procedures could be improved to utilize new decision-making tools.

MATERIALS AND METHODS

Information about the New Zealand fire reporting system and available statistics was primarily gained through interviews. Interviews took place from April to June 2005. Fire managers and data stewards from Rural Fire Authorities (RFAs) were contacted, including the Department of Conservation (DOC), New Zealand Defence Force (NZDF), Territorial Authorities (TAs), and the New Zealand Forest Owners Association (NZFOA). They were asked how fire information is transferred from an incident, to a report, to an archived record, and how data are used in decision-making. Several people in the New Zealand Fire Service (NZFS) and National Rural Fire Authority (NRFA) national offices in Wellington were also interviewed regarding how fire data are obtained, coded, used for decision-

making, and summarized for reporting. These staff included the National Rural Fire Officer (NRFA), Finance and Administration Officer (NRFA), Manager of Rural Fire Legislation/Operations (NRFA), Information Analysts (NRFA and NZFS), and Manager of Data and Information Services (NZFS). Personal interviews and access to the NZFS library led to most of the literature information sources.

BACKGROUND: Rural Fire Response Organization

There are several New Zealand entities responding to rural fires and recording wildfire statistics. It is necessary to understand the structure of the rural firefighting organization to understand how data are collected, organized and used. The relationship between these organizations can be confusing because there are many volunteers, several independent rural fire authorities and two pieces of governing legislation.

The New Zealand Fire Service Commission coordinates urban and rural fire nationwide through the Fire Service Act (1975) and the Forest and Rural Fires Act (1977), although these Acts are currently under review (DIA 2004). The Commission appoints a Chief Executive of the NZ Fire Service (NZFS) to oversee all fire activities and the Chief Executive is responsible for the appointment and management of the National Rural Fire Officer. The National Rural Fire Officer oversees the National Rural Fire Authority (NRFA), which is responsible for national rural fire policy, standards in the form of Fire Plans, auditing compliance with those standards, coordinating suppression resources, and rural fire reimbursement. Rural firefighting is the legislated responsibility of over 80 independent Rural Fire Authorities (RFAs). RFAs are responsible for areas outside of urban fire districts, which encompass 97% of New Zealand's land base. The NRFA has had little authority over independent RFAs except to ensure compliance with Code of Practice guidelines through a local auditing procedure that was detailed in the Code of Practice Workbook (NRFA 2000). However, the 2005 Regulations[1] may provide an opportunity for more oversight. New Fire plans compliant with the new standards must be written before September 2005 and will be directly approved by the NRFA.

There is an overlapping response system in place for rural fires where both rural and urban firefighters participate. The RFAs consist of the Minister of Conservation (Department of Conservation) for all state areas, the Minister of Defence (New Zealand Defence Force) for all defence areas, Rural Fire District Committees where there is a RFD, and TAs for all land otherwise unbounded

[1] The Forest and Rural Fires Act 2005 Regulations were adopted on 7 June 2005. Fire plans are regulated under sections 39-46. Previous to this, standards were in the form of a Code of Practise authored by the National Rural Fire Authority.

and outside of urban districts. There is a network of over 400 NZFS 'urban' stations covering 3% of New Zealand's land area, including some of New Zealand's smallest towns, and specialized private brigades operate in major industrial or commercial installations such as airports (NZFS Commission 2004). RFA firefighters are mostly volunteers, with the exception of DOC and the NZDF.

RFAs are responsible for most of the land area, but the NZFS is the first responder to approximately 80% of rural fires because many stations are on 24-hour standby and immediately notified via the 111 system (DIA 2004). If a wildfire incident is geographically 'rural', there are protocols among stations to transfer command to the Rural Fire Authority and cooperate as needed to control the fire. In some cases, special agreements allow for Rural Fire Authorities to manage geographically urban areas, such as parcels of vegetation in suburbs (DIA 2004). Sometimes this is reversed and individual RFAs contract the NZFS to provide rural firefighting services (C. Hopman and K. Ellem, pers. comm.). Local resource coordination is essential to make the system work for rural fire response.

Although all RFAs have been traditionally required to comply with the Code of Practise standards (NRFA 2002), the numerous types of local, state and private organizations have different ways of handling rural fire responses. There are over 60 Territorial Authorities (TAs) (city and district councils), providing local government services for communities. Some designate a part-time Principal Rural Fire Officer (PRFO) with the flexibility to plan and implement rural fire programs; other TAs defer to the larger Rural Fire District. Local NZFS units and TAs usually cooperate and let the NZFS handle initial attack for vegetation fires in the TA. The PRFO is usually not notified of a short-duration incident, though PRFOs are expected to be on-scene and assume command for vegetation fires lasting (or expected to last) more than one hour (C. Hopman, pers. comm.). Smaller private forestry companies are similar to TAs in that they also depend on initial attack from other sources, such as the RFD. Larger forestry companies may be the designated Rural Fire District and have adequate and well-trained firefighting staff (K. Ellem, pers. comm.). Many forestry companies have their own firefighting staff regardless of inclusion in an RFA or RFD. Regardless, local cooperation is critical for smaller areas few fire personnel and is less important for larger, well-funded organizations.

DOC and NZDF are two state organizations with well-developed fire organizations. DOC manages 30% of New Zealand's land base for conservation through thirteen Conservancies; eleven have designated PRFOs, and two are part of local RFDs. Many areas are large and remote with continuous fuels; therefore almost every managed area has a rural firefighting

staff and initial attack equipment (T. Teeling, pers. comm.). The NZDF also maintains initial attack resources, but for the unique reason that wildfires usually result from military training activities (M. Owen, pers. comm.). The NZDF Fire Authority is divided into eight Defence Rural Fire Districts, each with a PRFO and firefighting capability. Some NZDF installations rely on others for initial attack, such as the NZFS for urban Air Force bases, and local TAs for rural Defence areas that are not gazetted. When NZDF personnel use non-NZDF land for training, they often implement a Memorandum of Understanding to provide wildfire suppression capability during their training exercises. The NZDF does not rely as heavily on cooperation from adjacent RFAs unless fires threaten to escape initial attack (G. Olynsma, pers. comm.). Regardless of on-scene cooperation, all fire organizations typically cooperate and communicate through representation on Regional Rural Fire Committees.

REPORTING PROTOCOLS

There are several systems in place for getting fire details from the incident to an archived report. Some procedures are computer-based, others rely on paper forms. The NZFS has created a nation-wide system for recording all fire events through the Station Management System (SMS). SMS was primarily designed for the NZFS, but also includes vegetation fire statistics. Fire reporting is accomplished in different ways by the many rural firefighting organizations in New Zealand. Reporting among organizations sometimes overlaps, paralleling the overlap in rural fire response.

Before June 2005, all RFAs recorded vegetation fires as outlined in the now-defunct Code of Practise (NRFA 2002), a document that dictated committee constitutions, minimum standards of cover, general standards, competencies, inventories, voluntary rural fire forces, the audit process, and fire plan requirements. Fire documentation included a fire reference number, date, location, attending organizations, type of fire, vegetation type, hectares burnt, and NRFA notification. The newly required Fire Plans written by each RFA must clearly identify the system for recording fire incidents attended by firefighting units in the Fire Authority's district[2]. The Code of Practise will be replaced with an "Audit and Assessment" system that is still under development and will include a section on incident reporting (M. Davies, pers. comm.). At this time, incident-reporting protocols are not available.

Additional details regarding fire suppression and control activities must be recorded when cost recovery from the Rural Fire Fighting Fund (RFFF) is likely (NRFA 2003). The National Rural Fire Officer requests maps when fire suppression exceeds $1000 and costs are submitted to the RFFF for

[2] Forest and Rural Fires Act (1977) 2005 Regulations, section 45.

reimbursement. The NRFA could potentially withhold reimbursement through the RFFF if it found the RFA was non-compliant with standards in the Code of Practise.

Traditionally, fires are reported to the NRFA on paper "Annual Return of Fires" forms (Appendix A). This form is a carryover from the NZ Forest Service era. Although the 'Fire Incident and Reporting System 2000' database was designed with the intention of replacing the need for the Annual Returns, this manual process is still used. The form requires number of fires, area by vegetation burnt, and number of sawmills burnt; all listed by cause categories. The form provides only a summary of fire occurrence. The form also requires single entries for total fires, fines, costs, and damages awarded. Individual RFAs submit the form annually to their regional NRFA representatives.

The NZFS uses a computer application for comprehensive station management and all-risk incident data at the central dispatch location and station level (Anon. 2003). There have been several iterations of data systems over the past decade: the Fire Incident and Reporting System (FIRS1) in 1986; the Fire Incident and Reporting System (FIRS2000) in 2001; the Fire Incident and Risk Management System (FIRMS) in 2003; and the current Station Management System (SMS) in 2004. When one of the three national communication centres receives a 111 call, SMS uses the address of the caller's telephone or mobile tower location to automatically generate the location of an emerging incident in an SMS Incident Report. Dispatchers also fill in other information such as the type of incident. The choice of incident type dictates the type of data required in the report. For example, a motor vehicle accident prompts make and model of the vehicle, while a vegetation fire prompts hectares burnt. Post-incident details and correction of emergent details are the responsibility of the attending personnel who access SMS Incident reports from their stations. Access to system reporting modules are limited depending on the type of login access a user is granted, and the station that has been assigned to complete the report. Reports are a combination of standardized "pick lists" and free text. SMS Incident reports are usually completed on-line, but can be completed by fax or telephone (M. Macfarlane and K. Majorhazi, pers. comm.). NZFS firefighters are required to use the system and receive training; the result is completed reports for approximately 99% of 111-initiated incidents and the ability to generate comprehensive activity statistics and trends (NZFS 2004).

RFAs have been instructed to use the SMS reporting system designed for the NZFS, but the Annual Return of Fires has still been required (NRFA 2000b, 2003b, and 2004). All rural fires called in through the 111 system automatically generate an SMS Incident report. PRFOs or other rural firefighters are expected to access the system and fill in fire details or correct

fire details if it was their incident (Anon. 2001). During data input, PRFO access is limited to screens related to vegetation fires and incident reports assigned to the PRFO. The nature of the legislation does not allow the NRFA to require the use of SMS, only the Annual Returns form. Since 2000 when the computerized system became available, there have essentially been two reporting systems in place (M. Dudfield, pers. comm.).

RFAs have had to comply with the Code of Practise, but all have different ways to capture and report their fire statistics. In some cases, TAs keep their own statistics and send them directly to the NRFA on the Annual Return of Fires form (M. Macfarlane, pers. comm.), but others download data from SMS to populate the Annual Return of Fires form (C. Hopman, pers. comm.). Downloading from SMS works especially well when the NZFS responds to most vegetation fires in a TA because the NZFS has a high report completion rate, capturing nearly every fire event.

Every fire in Defence RFDs generates a paper-based NZDF Fire Incident Report. The Fire Incident Report is forwarded to the Assistant Director of Emergency Services Management where it is electronically logged in an internal database. Access to this wildfire database is described as "complicated" and it is suggested that these data would be difficult to interpret and analyze (M. Owen, pers. comm.). The NZDF dispatch is notified when a vegetation fire occurs to avoid unnecessarily assigning a civilian-based fire appliance. Fires that require an involved suppression response are also logged internally through the dispatching system, providing additional fire information. NZDF fires are not reported to SMS except when a fire is reported through the 111 system or civilian fire appliances assist; this is rare and upon request from the NZDF (G. Olynsma, pers. comm.). SMS Incident Reports, when generated, are completed on-line by Defence RFD PRFOs. Vegetation fires are also submitted by the NZDF via the Annual Return of Fires process, as evidenced by data from the NRFA. Presumably, Annual Return of Fires data comes from the NZDF Fire Incident Reports.

The New Zealand Forest Owners Association (NZFOA) Members record fire statistics differently depending on the amount of land area administered. Larger land areas are more likely to keep their own internal fire statistics and manage their own Rural Fire Districts, while smaller areas are located within TAs or RFDs and may not keep any fire statistics at all. NZFOA members with smaller land areas depend on local cooperation for fire control (K. Ellem, pers. comm.). Fire response is usually aggressive, especially considering the NZFOA does not have access to reimbursement of costs from the RFFF. Nearly all vegetation fires are attended by the RFD or TA and fires are recorded using the responding units' protocols.

Department of Conservation Local Area Managers complete an internal Record of Fire form (Appendix B) when a wildfire starts and submit the record to the Conservancy. Each Conservancy has some ability to control fire statistics reporting protocols through the chain-of-command and some Conservancies require the form is completed and submitted within 10 days of the fire being declared "out". Conservancy PRFOs also log the fire in their own recording system, usually consisting of a bound notebook and sometimes an additional electronic spreadsheet (T. Teeling, pers. comm.). A further incident record is often logged through dispatch communication procedures. Some Conservancies appear to have solid reporting systems in place whereby all fires are known to be tracked through frequent and open verbal communication between the PRFO and Area Managers. Some PRFOs require that GIS shapefiles are submitted with perimeters and/or point data, and have made a personal effort to diligently track all fires. All Records of Fire are submitted to the DOC National Fire Coordinator where they are logged into a national electronic spreadsheet. Conservancy PRFOs have SMS access and are to complete incident reports for DOC fires.

DATA SUMMARY: Data Fields, Dates, and Format

SMS

An electronic vegetation fire SMS Incident Report has 85 fields; not all are required for every fire (Appendix C). Cost and loss information is not collected. I did not have on-line SMS access to assess available pick-list choices and a user's guide was unavailable, therefore field names in Appendix D were taken from a vegetation fire SMS Incident Report. Hard-copy incident records for SMS and prior systems are held since 1987 (Table 1). Paper records held by the NZFS prior to 1998 would take tremendous effort to summarize, but electronic records are available from 1998 (M. Macfarlane, pers. comm.). These electronic data can be requested from the NZFS for analysis of SMS-reported vegetation fires from 1998 to the present.

Annual Returns

The Annual Return of Fires form has 23 fields that serve to summarize all fires in a local area over a period of one year (Appendix D). The form is not designed to track individual fire sizes or dates, only total annual area burned and number of fires by both cause category (Appendix E) and vegetation type. Annual cost data for the RFA is an entry field on the form. Annual Return data are stored by the NRFA in a Microsoft Access database from 1988 to present but does not include all fields on the form, such as annual costs. Some summarized fire data are available from 1986 to 1987 (Table 1). Earlier hard-copy records are unavailable. Electronic suppression cost data are

available from 1990 to present for large fires submitted to the RFFF (A. Craig, pers. comm.).

Table 1. Available statistical vegetation fire data by time period and quality of information.

Time Period	Plantation Burn Records	NZ Forest Service	DOC	NZDF	NZ Fire Service	Annual Returns	Local RFA Records	NZ FOA Records	RFFF Claims
1936-1944	3							6	
1945-1986	3	3, 7						5	
1987	3	3, 7	1		6	3		5	
1988	3		1		2	3		5	
1989	3		1	8	2	3		5	
1990	3		1	4	2	3		5	1
1991	3		1	4	2	3		5	1
1992	3		1	4	2	3		5	1
1993	3		1	4	2	3	6	5	1
1994	3		1	4	2	3	5	5	1
1995	3		1	4	2	3	5	5	1
1996	3		1	4	2	3	5	5	1
1997	3		1	4	2	3	5	5	1
1998	3		1	4	1	3	5	5	1
1999	3		1	4	1	3	5	5	1
2000			1	4	1	3	2 &/or 4	5	1
2001			1	4	1	3	2 &/or 4	5	1
2002			1	4	1	3	2 &/or 4	5	1
2003			1	4	1	3	2 &/or 4	5	1
2004			1	4	1	3	2 &/or 4	5	1
Presently collected			1	4	1	3	2 &/or 4	5	1

1 electronic records, individual fires, comprehensive data fields
2 paper records, individual fires
3 electronic records, summarized annual data
4 electronic records, individual fires, limited data fields
5 records may be available; status highly variable
6 the first year of records is unknown
7 individual fire information is contained in remarks sections

RFA Records

The Rural Fire Authorities (RFAs) include Department of Conservation lands, New Zealand Defence Force lands, Rural Fire District Committees where there is a Rural Fire District, and Territorial Authorities (TAs) for all land otherwise unbounded and outside of urban districts. Every RFA presumably has a paper record of all individual fires in compliance with the Code of Practise, though information about each fire would be limited to those required (Appendices D and E). Some RFAs choose to keep electronic records by manually entering local fire data or downloading data from SMS. Others keep paper notebooks with a running tally of fire records from year to year.

The exact status of local RFA records in regards to dates and formats is unknown, including those records of TAs (Table 1). Some RFAs and private companies have internal fire occurrence recording systems.

Department of Conservation

All DOC Conservancies maintain paper records via DOC's Record of Fire form, which has 58 data fields (Appendix D). Each Conservancy also keeps a bound notebook with chronological lists of fires and assigned Area Fire Numbers for internal financial tracking. This financial tracking allows for cost information to be obtained on each fire. Some Conservancies maintain locally designed electronic spreadsheets to aid their fire tracking. DOC fire cause codes are listed in Appendix E. Vegetation fire data for DOC is available from local Conservancies in a variety of formats. The national electronic spreadsheet of vegetation fires contains information from DOC's establishment in 1987 to the present and is available for analysis (Table 1).

New Zealand Defence Force

There are approximately 16 data fields on the form used internally by NZDF (Appendix D), but a copy of the form was unavailable. Fire causes are different from non-military wildfire incidents due to the use of pyrotechnic devices, but the exact cause categories are unknown. Vegetation type and fire weather variables or indices are not recorded (M. Owen, pers. comm.), although Annual Returns data for Defence Rural Fire Districts show hectares burned by vegetation type. Fire behaviour is recorded as part of incident communications and dispatch procedures, kept in separate records. Cost information is seemingly not recorded, but value is a field on the form. All wildfire data is centrally logged in an electronic database managed by the Assistant Director of Emergency Services Management. The NZDF estimates they have 15 years of wildfire data, but the exact extent is unknown (M. Owen, pers. comm.). It may be possible to acquire the NZDF fire statistics database or portions of it for analysis (Table 1).

NZ Forest Service and Plantations

Summarized fire data are available in NZ Forest Service Annual Reports from 1945 to 1987, but the format of the raw data, if it exists, is unknown. The data are summarized by year with broad categories that do not indicate individual fire statistics such as date and size (Appendix D) except when noted in remarks. Some remarks have individual fire information such as general area, size, and vegetation type. Fire cause categories for the NZ Forest Service are different from those used by other agencies (Appendix E). Some paper records were located that document the cost of fire suppression for the NZ Forest Service and other forest owners during partial periods from 1971-1983 (Table 1) (unpublished data on file at Ensis).

There is little consistency among Forest Owners Association members in the type of plantation fire statistics recorded, the amount of historic records available, or the format of the records. Summarized plantation fire data are available from 1936-1999 (unpublished data on file, "New Zealand Plantation Burn Records" at Ensis). Small companies probably have had most fires accounted for through the RFA (and therefore accounted for in Annual Return of Fires or SMS data) and do not choose to keep their own records (K. Ellem, pers. comm.). Larger forest companies keep their own statistics, but they are all different apart from meeting RFD requirements. NZFOA fire statistics may be available from individual enterprises if they are not determined sensitive corporate information.

FINDINGS AND RECOMMENDATIONS

Consistent vegetation fire data fields are lacking among rural fire management agencies. DOC probably has the most consistent record of comprehensive vegetation fire data for individual fires and keeps an electronic database. Although the NZDF apparently has some fire records, the fire cause and frequency data do not likely reflect non-military situations and would not be applicable to the rest of the nation. Also, the NZDF data are not in an updated, accessible database. Plantations evidently do not keep individual fire data outside of that required by the RFA. SMS vegetation fire records have comprehensive fields, but the accuracy and completeness of the data is suspect. Finally, although all RFAs collect standardized data fields, the data collected will not support analysis of relationships between fire occurrence and environmental variables. Besides inconsistency with the types of data collected, there are issues concerning protocols for transferring data from individual incidents to archived records.

Annual Returns

RFAs must record all fires and are audited to ensure compliance, but whether those fires are actually reported in the Annual Return of Fires process is unknown. The auditor checks for physical records with correct data fields (J. Barnes, pers. comm.), and the Wellington office checks that a form arrives from the same RFA (A. Craig, pers. comm.), but there is no data quality protocol. Establishing quality control procedures has been difficult without a central dispatching office that can be responsible for area-wide records. Although Annual Return of Fires data are still submitted to Wellington and summarized in a spreadsheet, they are not used because RFAs have been instructed to use SMS for all reporting. Future data analysis of Annual Return of Fires data must be aware that data omissions cannot be quantified.

Using SMS for Vegetation Fire Data

Some fire managers maintain that the 111 system and resulting automatic SMS report allows tracking of nearly all fires nationwide; others suggest this is not the case and some RFA fires are not reported in SMS. There are conflicting views on whether local RFAs can access SMS in regards to computer hardware or computer literacy. Individuals have suggested that computer access does not prevent SMS reporting, but people do not take the time to input and provide accurate fire information. This may be due to a lack of understanding about the value of incident statistics. SMS appears to contain sufficient data fields for housing appropriate fire occurrence data. Considering that most incidents are reported through the 111 system, SMS probably has much better records of fire occurrence than fire location, vegetation type, or area burnt. The problem with SMS is not in the way it logs incident occurrence, but in the way the system is used (or not used) by those people with adequate knowledge of an event.

SMS compliance cannot be easily ascertained because Annual Returns data cannot be checked against SMS data. There are no unique data relationships to tie records together (K. Majorhazi, pers. comm.). A unique numbering system for all rural fire responders is worthy of investigation. The US Forest Service uses a system that incorporates unique numbers for each region, forest, and district, a consecutive number, plus the year of occurrence to create a unique fire identifier (USDA Forest Service 1995). A similar reporting field plus a corresponding SMS data field would enhance quality control because local fire records could be checked for inclusion in SMS.

SMS vegetation fire reporting errors occur because pre-filled information during initial stages of the incident is not corrected after the incident or users are not well trained. Some fire managers may avoid SMS because they do not see value for their investment. The current annual statistical summary provided by the NZFS does not provide data summaries useful for RFA decision-making. The reasons data are not corrected are because the report is not assigned to the proper fire official in SMS and therefore inaccessible, the person with the correct information does not log in to SMS to complete the report, or the person who logs in does not actually check the data fields, but only validates that data exist and closes the report.

An external report of FIRS2000 data quality identifies the problem with "risk classification" that continues to plague SMS vegetation fire response and reporting (Catsburg 2002). Incorrect operational boundaries in the SMS geographic layers are used to classify a fire as urban or rural, thus dictating the response. Although this problem now has the attention of national fire managers, it affects data collected to date because rural fires may have been mistakenly classified as urban.

One questionably useful feature of SMS is that it locates the nearest weather station, downloads current weather data, and calculates the fire indices, which links them directly to the fire report. However, incorrect incident locations result in weather downloads from less desirable stations. Local fire danger assessments to validate the NZFDRS will require indices are calculated for all days in the weather record, not just days with fires. It is also possible that the NZFDRS models could change, in which case it will be important to use the raw weather data to recalculate fire indices. Since raw weather data are available elsewhere, these SMS data fields have limited value. Ensuring an SMS data field that can link each fire occurrence with available raw weather data would be more useful for future analyses.

Fire Locations, Causes and Area Burnt

SMS vegetation fire reports have inaccurate vegetation fire information, and although the inaccuracies cannot be quantified, there have been internal and external studies. One internal report compared RFA logs with the FIRS database (now SMS) for 528 incidents in 2000-2001 (Majorhazi 2001). Only 48% of incidents were in FIRS as determined by matching fire locations between the logbook and FIRS. The study found none of the 'area burnt' information was the same, although the comparison was performed by computer and had to be exact. Even so, if the RFA's logbook is used as a reference for filling in the online SMS report, at least some identical entries would be expected. Not only are area burned entries not identical, some differ by a factor of 18 when comparing NZFS data and RFA data (M. Macfarlane, pers. comm.). Field references for firefighters could help by providing guidelines for pacing fires to estimate area (National Wildfire Coordinating Group 1998). Burnt area can be coded during analysis for easier interpretation, such as using "Class A" to represent fires of 0-0.1 hectares, but this should be avoided for fire reporting. Since 2004, SMS data are used for official rural fire statistics, including area burnt.

Majorhazi (2001) found that fuel type matched in 77% of records, but a different internal study found 40% of vegetation codes were wrong when comparing the SMS code with text in the same SMS report (M. Macfarlane, pers. comm.). It is common to find many crop stubble and native vegetation fires with fire location coordinates in urban areas of Auckland and Christchurch. Even though these fuel types are uncommon in urban areas, SMS creates the initial fire location based on origination of the 111 call. According to data managers, there are several examples where vegetation burnt is coded as "unknown" when the text of the report clearly identifies the vegetation type, or where items like a bird's nest or a burning hay barn is classified as a "vegetation fire" because that is what the fire burned (M. Macfarlane, pers. comm.). When SMS is queried for vegetation fire statistics, it

is not clear if precautions are taken to exclude fires that are obviously not valid wildland fires. Business rules can be established to identify these types of "non-statistical" wildfires (USDA Forest Service 1995).

With over 70 SMS fire cause codes, it is impossible for some fire mangers to choose the most appropriate one. The NZFS Annual Emergency Statistics for 2003-04 shows vegetation fire causes that are not mutually exclusive (NZFS 2004) (Appendix E). For example, a fire cause can be coded as "Deliberately Lit Fire: controlled burn/land clearing" or "Extreme Conditions: High Wind". The latter cause may be a contributing factor, but not an actual cause, yet contains nearly 5% of all vegetation fires recorded that year. Vegetation fires classified as either "extreme conditions", "unknown", "not completed", or "unable to classify" comprise over 17% of the vegetation fires for 2003-04. Poor quality data such as these cannot be effectively used to make decisions about where and how fires occur, hindering efforts to develop targeted prevention programmes or mitigation plans.

In addition to inherent problems with cause classes in SMS, different fire cause categories are used by DOC, the Annual Return of Fires, the NZ Fire Service, NZDF and SMS (Appendix E). Agencies use different codes because they have different needs, but this is problematic for nation-wide summaries or analyses. The challenge in developing a new system will be preserving crosswalks back to historic fire data. SMS has confusing categories that are not mutually exclusive, lumping who was responsible with the fire ignition mechanism. A hierarchical cause category system designed for vegetation fires is needed. Ideally, separate fire cause fields would be used for the ignition mechanism and responsible party. The categories used by US wildfire agencies may be a useful starting point (USDA Forest Service 1995). More appropriate cause categories will allow data to be collapsed into a few recognizable categories for regional or national summaries, but also allows area managers to know exactly how to target local fire prevention and mitigation activities.

A temporary solution to achieving better data may be to reinstitute the paper form. Although this can be perceived as a step backwards, a sophisticated database system is not truly a step forward if it does not house accurate data. A paper form that mimics the SMS Incident Form can be developed to represent a single incident. Examples of forms currently used by wildfire management agencies in the US are available as a starting point (Appendices F and G). Clear instructions for fields would be necessary, as well as procedures for faxing or mailing the form to regional data stewards who would be responsible for checking fires against SMS. The sooner procedures are in place for obtaining accurate fire statistics, the sooner analysis tools can

be used for decision-making because several years of data are usually required.

Costs and Losses

There are few records to indicate the economic impacts on people, property, and natural resources or the cost of fighting fires in New Zealand (Craig 2002). Some cost data are available, but it is usually limited to large fires where an RFFF claim is made, with the exception of DOC records. Although NZDF has "value" as a data field, whether this is consistently populated is unknown. Some data on suppression cost and value is available in plantation records, but it is not consistently available nationwide. If understanding economic impacts of wildfires is important, managers must incorporate these data into fire reporting forms and define methods for calculating these figures.

Key Findings

Most of the issues surrounding fire data collection are not insurmountable, but fixing them requires effort.

1. Attention to standardizing the cause categories is urgent. National standards for general cause classes should be implemented, with separate data fields for specific classes. Determining cause classes appropriate to New Zealand will require participation from all rural fire responder groups.
2. Rural fire reporting compliance with SMS is unknown. This issue can be corrected by instituting a nationwide fire numbering system with unique codes for regions and districts that are common to the local reporting process and the SMS process.
3. Fire managers must create opportunities to train rural fire responders in SMS procedures and teach them why the data are important. This type of technology transfer can be added to training classes already attended by fire managers.
4. A paper form that mimics the SMS Incident Form can be developed to represent a single incident and help ensure fire information is properly recorded.
5. The SMS data fields for area burnt contain unreliable information, even though they are used to compile national statistics. A pocket reference for firefighters can be easily developed.
6. Ensuring an SMS data field that can link each fire occurrence with available raw weather data would be useful for future analyses.
7. Vegetation fire data in SMS must be analyzed to provide useful information for the RFAs. The NRFA should ensure these analyses are part

of the annual statistical report prepared by the NZFS or create their own report.

8. The economic impact of fire and the cost of fighting fires in New Zealand is not recorded. If these data are deemed important, a new SMS data field is required.

The sooner these issues are resolved, the sooner there will be sufficient fire occurrence data to support sophisticated decision-making tools that rely on statistical fire information.

FURTHER WORK

The overall goal of this FRST task is to analyze fire occurrence, causes and impacts related to fuels, weather, and topography to understand fire risk. This type of analysis can be performed using fire occurrence data with the New Zealand Fire Danger Rating System (NZFDRS) to understand specific fire index thresholds that indicate some level of fire risk in specific geographic areas. Such an analysis requires individual fire data including fire start date, time, fire location, area burnt, topographic descriptors, fuel type, cause, and fire weather. Very few datasets meet these requirements (Table 1), highlighting a serious New Zealand fire management issue deserving urgent attention.

The Department of Conservation (DOC) dataset could be used for studying initial relationships between fire occurrence and environmental factors using the NZFDRS. DOC has comprehensive individual fire data and a continuous record from 1987 to the present. With responsibility for 30% of the land base, there is little doubt DOC would benefit from such an analysis, and since DOC lands span the entire nation, the results might be extrapolated to non-DOC lands. Additionally, DOC's land management goals could become more complex than a suppression-only approach. Fire ecology information combined with conservation goals may steer future DOC managers to accept and manage some amount of fire on the landscape without immediate suppression. This shift in management focus will require that DOC has site-specific prediction and decision-making tools regarding fire behaviour, fire danger, and fire effects.

Rural Fire Fighting Fund claims from 1990 would be useful for analyzing large fire occurrence and environmental factors. Often, these are the fires that escape initial attack or pose control difficulties and are of great interest to fire managers. A nationwide assessment of how well NZFDRS indices are related to fires at the upper end of the spectrum could prove useful. Depending on the datasets used, any analysis must account for changes in systems and data fields when identifying data trends or anomalies.

Although SMS has individual fire data, records before 1998 are not electronic and the data accuracy (apart from occurrence) is suspect for use as a nationwide summary. Annual returns data have little value for evaluating fires in the context of their environment because there is no indication of seasonality, topography, or local weather. These data can only be used to summarize fire seasons in terms of area burned by fuel type and number of fires, but without coinciding locations and weather records, little can be determined as to why these particular fire years occurred. A useful study would involve determining the most appropriate vegetation fire data fields. In the US, each fire agency uses its own standardized paper-based fire report form to document fire occurrence, related fire behaviour and suppression actions. However, many of the categories on the form are standardized across all agencies. Examples of standardized codes are fire cause (general and specific), the type of person responsible for fire ignition, environmental variables (slope, aspect, general topography), land ownership, initial attack tactics used, cost categories, fire intensity level, and fuel model. The fire reports build the national statistical fire database and provide individual agencies with data for monitoring prevention and suppression performance, and for designing the most cost-effective suppression organizations.

CONCLUSIONS

Although there are nationwide standards for fire reporting, the data that are collected are insufficient for analyzing fire occurrence and environmental factors. The fire occurrence database most closely resembling a national vegetation fire occurrence database is the SMS database administered by the NZ Fire Service; however, high-quality wildfire occurrence data for analysis are lacking. Data more appropriate for the task of evaluating fire occurrence and environmental factors are located in the fire database maintained by the Department of Conservation and the Rural Fire Fighting Fund database for large fire reimbursements.

The structure and legislation governing rural fire management is complicated, thus complicating fire reporting protocols and data systems. Improved fire statistical data, including when, where, how, and what types of fires occur, can be used to improve management of fire risk. Simplified and limited fire cause categories would aid future data analysis and fire prevention activities. Previously developed fire cause categories are available that may provide a helpful starting point. Understanding national economic impacts of wildfires and costs of suppression can only occur with improved cost and loss reporting. Increased focus on managing data flow from incidents to archives will improve fire data quality.

This report summarizes existing vegetation fire data in New Zealand to determine which data are appropriate for future analysis of fire occurrence and environmental factors using the NZFDRS and identifies some problems with available data. People responsible for managing vegetation fires in New Zealand understand that continuing changes in land use and the environment will require improved strategies for safe and effective fire management. Such strategies require attention to improving fire statistical databases and analysis of fire occurrence data.

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APPENDICES

Appendix A—Annual Return of Fires Form

Appendix B—Department of Conservation Fire Report Form

Appendix C—Sample SMS Incident Report

Appendix D—Fire Reporting Data Fields by Organization

Appendix E—Fire Cause Categories by Organization

Appendix F— US Forest Service Wildfire Report Form

Appendix G— US National Park Service Wildfire Report Form

Appendix A—Annual Return of Fires Form

FOREST AND RURAL FIRE REGULATIONS 1979

FSC 803/1991
Reg. 50

RETURN OF FIRE AUTHORITY FOR THE .....

For the period 1 May 20..... to 30 April 20 .....

Name of Fire Authority: .....

Names of Rural Fire Officers: .....

Principal Rural Fire Officer: .....

.....

.....

Period or periods during which burning was prohibited and nature of other prohibitions imposed under sections 20, 21 and 22 of the Forest and Rural Fires Act 1977: .....

Total number of fires reported: .....

General remarks: .....

.....

.....

PARTICULARS OF FIRE REPORTED

Cause of Fire	Number Caused	Area of Ground Cover Burnt			Number of Sawmills Burnt
		Grass (hectares)	Scrub (hectares)	Forest (hectares)	
Road Traffic					
Tractors and motor vehicles					
Railways					
Hunters (camp or billy fires, etc.)					
Picnics					
Smokers					
Land Clearing					
Incendiary					
Industrial (sawmill, logging, etc.)					
Chainsaws					
Miscellaneous					
Unknown					
Totals ...					

Number of prosecutions for offences against the Act: .....

Number of convictions entered: .....

Summary of charges: .....

Total amount of fines imposed: $.....

Total amount of costs imposed: $.....

Total amount of damages awarded: $.....

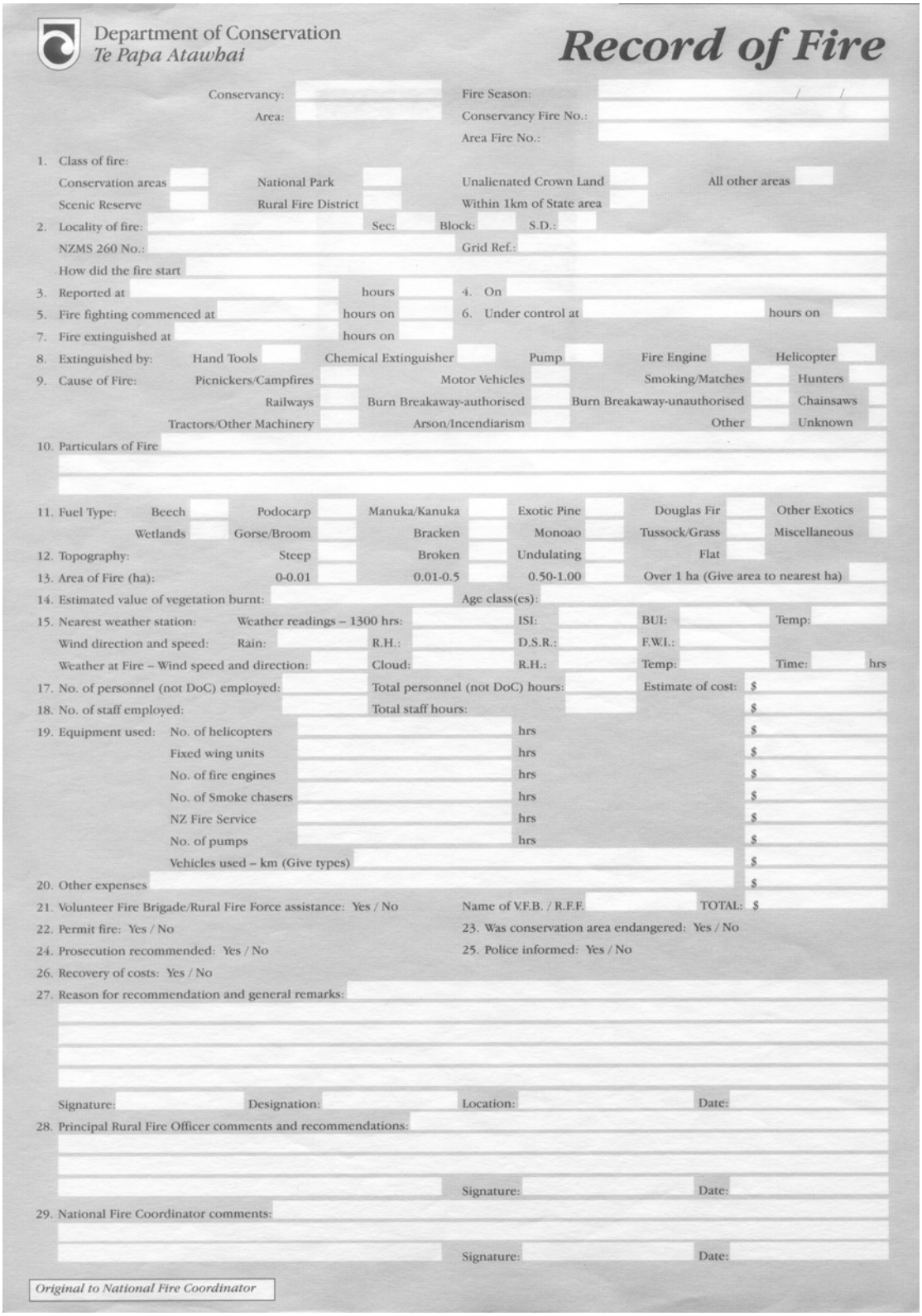
General comments and suggestions: .....

Signature: .....
for Fire Authority

Date: .....

To be forwarded to the National Rural Fire Officer through the Managers Rural Fire 82562H - 500/3/88 MK

Appendix B—Department of Conservation Fire Report Form



Department of Conservation
Te Papa Atawhai

Record of Fire

Conservancy: Fire Season: / /
Area: Conservancy Fire No.:
Area Fire No.:

1. Class of fire:
   Conservation areas | National Park | Unalienated Crown Land | All other areas
   Scenic Reserve | Rural Fire District | Within 1km of State area
2. Locality of fire: Sec: Block: S.D.:
   NZMS 260 No.: Grid Ref.:
   How did the fire start
3. Reported at hours 4. On
5. Fire fighting commenced at hours on 6. Under control at hours on
7. Fire extinguished at hours on
8. Extinguished by: Hand Tools | Chemical Extinguisher | Pump | Fire Engine | Helicopter
9. Cause of Fire: Picnickers/Campfires | Motor Vehicles | Smoking/Matches | Hunters
   Railways | Burn Breakaway-authorised | Burn Breakaway-unauthorised | Chainsaws
   Tractors/Other Machinery | Arson/Incendiarism | Other | Unknown
10. Particulars of Fire
11. Fuel Type: Beech | Podocarp | Manuka/Kanuka | Exotic Pine | Douglas Fir | Other Exotics
    Wetlands | Gorse/Broom | Bracken | Monoao | Tussock/Grass | Miscellaneous
12. Topography: Steep | Broken | Undulating | Flat
13. Area of Fire (ha): 0-0.01 | 0.01-0.5 | 0.50-1.00 | Over 1 ha (Give area to nearest ha)
14. Estimated value of vegetation burnt: Age class(es):
15. Nearest weather station: Weather readings – 1300 hrs: ISI: BUI: Temp:
    Wind direction and speed: Rain: R.H.: D.S.R.: F.W.I.:
    Weather at Fire – Wind speed and direction: Cloud: R.H.: Temp: Time: hrs
17. No. of personnel (not DoC) employed: Total personnel (not DoC) hours: Estimate of cost: $
18. No. of staff employed: Total staff hours: $
19. Equipment used: No. of helicopters hrs $
    Fixed wing units hrs $
    No. of fire engines hrs $
    No. of Smoke chasers hrs $
    NZ Fire Service hrs $
    No. of pumps hrs $
    Vehicles used – km (Give types) $
20. Other expenses $
21. Volunteer Fire Brigade/Rural Fire Force assistance: Yes / No Name of V.F.B. / R.F.F. TOTAL: $
22. Permit fire: Yes / No
23. Was conservation area endangered: Yes / No
24. Prosecution recommended: Yes / No
25. Police informed: Yes / No
26. Recovery of costs: Yes / No
27. Reason for recommendation and general remarks:

Signature: Designation: Location: Date:

28. Principal Rural Fire Officer comments and recommendations:

Signature: Date:

29. National Fire Coordinator comments:

Signature: Date:

Original to National Fire Coordinator

Appendix C—Sample SMS Incident Report

SMS Incident Report

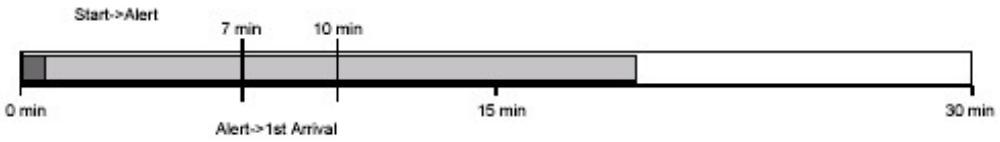
Printed on Thursday 16 Jun 2005 at 9:35 am

Summary

CAD Number	[redacted]	**Status**	Closed
Station	[redacted]ural Fire Party (See also [redacted])		
Incident Started	13:15, Sat 22 Jan 20[redacted]	**Incident Ended**	14:10, Sat 22 Jan 20[redacted]
Incident Type	1312: Vegetation Fire (specify Area of Vegetation burnt)		
Common Name			
Address	[redacted]		
Alarm Method	111 Telephone	**Alarm Level**	1
PFA Number			
Zone	125402	**Risk Classification**	R
Map Grid E	[redacted]	**Map Grid N**	[redacted]
First Caller	[redacted]	**First Caller Contact**	[redacted]
Incident Closed	14:24, Sat 22 Jan 2005		

Responses

Callsign	Type	Station Alert	Enroute Time	Arrival Time	Departed
PUKE5471	RP	13:16:03 22 Jan 2005	13:29:24 22 Jan 2005	13:34:41 22 Jan 2005	14:15:08 22 Jan 2005
KAIT721	P1	13:16:06 22 Jan 2005	13:19:03 22 Jan 2005	13:48:24 22 Jan 2005	14:10:43 22 Jan 2005
PUKE5476	RWT	13:27:33 22 Jan 2005	13:28:26 22 Jan 2005	13:57:03 22 Jan 2005	14:16:13 22 Jan 2005
KAIT727	PR	13:16:06 22 Jan 2005			13:29:32 22 Jan 2005



Elapsed Times

Callsign	Start To Alert	Alert To Arrival	Start To Arrival	Start To Depart
PUKE5471	00:00:47	00:18:38	00:19:25	00:59:52
KAIT721	00:00:50	00:32:18	00:33:08	00:55:27
PUKE5476	00:12:17	00:29:30	00:41:47	01:00:57
KAIT727	00:00:50			00:14:16

Notifications

Date	Time	Party Notified
22 Jan 2005	13:16:58	AUPOURI KARIKARI RFD

Date	Time	Party Notified
22 Jan [redacted]	13:17:02	TIMBERLANDS NORTHLAND
22 Jan [redacted]	13:19:10	RFO CHH ACKN PAGE
22 Jan [redacted]	13:19:12	AUPOURI KARIKARI ACK PAGE
22 Jan [redacted]	13:20:22	FAR NORTH DC ACK PAGE - NO REPAGE
22 Jan [redacted]	13:41:57	AUPOURI KARIKARI RFD OF SITREP
22 Jan [redacted]	13:42:03	TIMBERLANDS NORTHLAND OF SITREP

Message Log

Time	Message
13:15:38	GRASS FIRE
13:15:38	ON AN ORCHARD
13:15:38	DRY GRASS
13:15:44	** Event A503283 was viewed at: 200501221315444ND
13:15:54	** Recommended unit PUKE5471 (3.11 km)
13:15:54	** Recommended unit KAIT721 (>32.52 km)
13:15:54	** Recommended unit KAIT727 (>32.52 km)
13:19:03	Unit KAIT721 [K1 : PROCEEDING TO INCIDENT]
13:19:49	** LOI search completed at 22/01/05 13:19:49
13:22:27	KAIT727 IS REMAINING ON STATION
13:28:26	Unit PUKE5476 [K1 : PROCEEDING TO INCIDENT]
13:29:24	Unit PUKE5471 [K1 : PROCEEDING TO INCIDENT]
13:29:32	Unit PUKE5471 [K7 : AT NORMAL STATION]
13:29:33	Unit KAIT727 [K7 : AT NORMAL STATION]
13:33:47	Unit PUKE5471 [K1 : PROCEEDING TO INCIDENT]
13:33:57	.
13:34:41	Unit PUKE5471 [K2 : IN ATTENDANCE AT INCIDENT]
13:36:55	Unit PUKE5476 [KC : UNIT CALLING]
13:38:15	Unit PUKE5476 [SITREP :] FO WAGNOR 50X 30 M GRASS FIRE ALMOST CONTAINED GTW
13:48:24	Unit KAIT721 [K2 : IN ATTENDANCE AT INCIDENT]
13:57:03	Unit PUKE5476 [K2 : IN ATTENDANCE AT INCIDENT]
14:09:34	Unit KAIT721 [KC : UNIT CALLING]
14:10:04	Unit KAIT721 [K47 : STOP MESSAGE: MESSAGE UNCHANGED FROM INFORMATIVE]
14:10:44	Unit KAIT721 [K4 : ON RT INSIDE NORMAL TURNOUT AREA]
14:15:08	Unit PUKE5471 [K4 : ON RT INSIDE NORMAL TURNOUT AREA]
14:16:14	Unit PUKE5476 [K4 : ON RT INSIDE NORMAL TURNOUT AREA]
14:24:44	** Assigned Result Code: VEG, Detailed Event Type: 1300, Qualifier 1: Q1,
14:24:44	Qualifier 2:

Incident

CAD Number	[redacted]
Incident Reporter	SSO[redacted]
Incident Controller	CFO[redacted]
Distance Travelled (km)	45
Delay In Receiving Call	

Property Details

Occupant	
Building Owner	
General Property Use	Farming, Horticulture, Agricultural use
Special Property Use	Orchard

Actions

Persons Reported Trapped	
Evacuation Status	No evacuation
Action Prior 1	
Action Prior 2	
Action Taken	Extinguishment only: Includes isolating fuel/power supply

Civilians

Civilians Rescued	
Civilians Extricated	
Civilians Assisted	
Civilians Evacuated	0

Origin

Location	
Level	

Equipment Used

Quantity	Equipment
2	Forestry pack
4	Forestry hand tools, Shovels, Beaters, Chainsaw, Scrub bar
4	Handheld Radio (or Cellphone)
1	Vehicle Radio (LMR)

Equipment Involved

Equipment Involved	
Year	
Make	
Model	

Fire

Arrival Condition			
Heat Source	Agricultural fire or burn off		
Termination Stage			
First Object Ignited	Scrub (living or dead)		
First Object Material	Gorse, Scrub		
Second Object Ignited			
Second Object Material			
Indicated Cause	Controlled burn, land clearing fire		
Certainty of Cause			
Age of Person	Persons: 17+ yrs		
Ethnicity	NZ European/Pakeha		
Gender			
FAIP Service Offered	No	**FAIP Service Accepted**	No

Vegetation

Gorse Area	0 m^2	**Forest Danger**	1
Grassland Area	0 m^2	**Grassland Danger**	0
Native Forest Area	0 m^2	**Scrubland Danger**	4
Exotic Forest Area	0 m^2		
Scrub Area	1,500 m^2	**BUI**	42.8867144775391
Tussock Area	0 m^2	**DC**	293.994537353516
Wetland Area	0 m^2	**DMC**	26.2104740142822
Crop Area	0 m^2	**FFMC**	84.1767044067383
Total Vegetation Area	1,500 m^2	**FWI**	13.2485122680664
		ISI	5.56723213195801
Map Grid N	[redacted]		
Map Grid E	[redacted]	**Wind Speed**	22km/hr
		Wind Direction	71°
Closest Weather Station	Aupouri Peninsula (APP)	**Rainfall**	0mm
Fire Season Status	R	**Humidity**	78%
Rural Fire Permit	Y	**Temperature**	22°C

Appendix D—Fire Reporting Data Fields by Organization (page 1 of 3)

SMS Incident Report (Veg)	Annual Returns Form	DOC Record of Fire	RFA Records	NZDF Form	NZForest Service
CAD Number	Rural Fire Authority Name	Conservancy	Fire Reference	Fire cause	Year
Status	Annual Period (Year)	Area	Date	Damage to property	State fires--number, native
Station	Name of Fire Authority	Fire Season	Location	Incident type	State fires--number, exotic
Incident Started	Names of Rural Fire Officers	Conservancy Fire No.	Attending Organizations	How call received	Non-state fires--number, native
Incident Ended	Principal Rural Fire Officer	Area Fire No.	Type of Fire	Who discovered incident	Non-state fires--number, exotic
Incident Type	Periods of burn prohibition (Dates)	Class of Fire (ownership)	Veg Type (no categories)	Applicance time of arrival	State fires--area burnt, native (ha)
Common Name	Total annual fires reported	Locality	Hectares Burnt	Time of assistance	State fires--area burnt, exotic (ha)
Address	General Remarks	Cause	NRFA Notification	Initial action	State fires--area burnt, other (ha)
Alarm Method	Particulars of Fires--Number of fires by Cause Category	Reported at/time/date		Number of responders	Non-state fires--area burnt, native (ha)
Alarm Level	Particulars of Fires--Area of veg type burnt by Cause (ha)	Suppression response time		Number of appliances	Non-state fires--area burnt, exotic (ha)
PFA Number	Particulars of Fires--Number of Sawmills Burnt by Cause	Control time		Fire extent (ha)	Non-state fires--area burnt, other (ha)
Zone	Particulars of Fires--Total number of fires	Extinguished (time)		Device used to extinguish	Comments
Risk Classification	Particulars of Fires--Total Area Burned by Veg Type	Fire Cause		Ownership	Significant individual fires
Map Grids E and N	Particulars of Fires--Total Number of Sawmills Burnt	Particulars (free text)		Value	
First Caller	Number of Prosecutions	Fuel Type		Area Net Cover Burnt	*summarized from annual reports
First Caller Contact	Number of Convictions	Topography		Remarks	
Incident Closed	Summary of Charges	Area burnt			
Responses (callsign, type)	Total amount of fines imposed ($)	Value of vegetation burnt			
Elapsed Times (callsign)	Total amount of costs imposed ($)	Weather station			
Notifications (date, time, party)	Total amount of damages awarded ($)	Weather--ISI			
Message Log	General Comments and Suggestions	Weather--BUI			
Incident Reporter		Weather--Temp			
Incident Controller		Weather--rain			

Distance Travelled (km)		Weather--RH			
SMS Incident Report (Veg)	**Annual Returns Form**	**DOC Record of Fire**	**RFA Records**	**NZDF Form**	**NZForest Service**
Delay in receiving call		Weather--DSR			
Property Occupant		Weather--FWI			
Property Building Owner		Weather at fire--wind speed			
General Property Use		Weather at fire--wind speed			
Special Property Use		Weather at fire--cloud			
Persons Reported Trapped		Weather at fire--RH			
Evacuation Status		Weather at fire--temp			
Action Prior 1		Weather at fire--time of obs			
Action Prior 2		Personnel--non-DOC			
Action Taken		Personnel--non-DOC, hours			
Civilians Rescued		Personnel--non-DOC, costs			
Civilians Extricated		Personnel--DOC, hours			
Civilians Assisted		Personnel--DOC, costs			
Civilians Evacuated		Equipment used, number, hours			
Origin (Location)		Other expenses			
Origin (Level)		Volunteer assistance (Y/N)			
Equipment Used and Quantity		Volunteer name			
Equipment Involved		Permit Fire (Y/N)			
Fire--Arrival Condition		Conservancy endangered (Y/N)			
Fire--Heat Source		Prosecution recommended (Y/N)			
Fire--Termination Stage		Recovery of costs (Y/N)			
Fire--First Object Ignited		Remarks			
Fire--First Object Material					
Fire--Second Object Ignited					
Fire--Second Object Material					
Fire--Indicated Cause					
Fire--Certainty of Cause					
Fire--Age of Person					
Fire--Ethnicity					

Fire--Gender					
SMS Incident Report (Veg)	**Annual Returns Form**	**DOC Record of Fire**	**RFA Records**	**NZDF Form**	**NZForest Service**
Fire--FAIP Service Offered					
Fire--FAIP Service Accepted					
Vegetation--Gorse Area (m2)					
Vegetation--Grassland Area (m2)					
Vegetation--Native For. Area (m2)					
Vegetation--Exotic For. Area (m2)					
Vegetation--Scrub Area (m2)					
Vegetation--Tussock Area (m2)					
Vegetation--Wetland Area (m2)					
Vegetation--Crop Area (m2)					
Vegetation--Total Area (m2)					
Vegetation--Map Grid N and E					
Vegetation--Closest Wx Station					
Vegetation--Fire Season Status					
Vegetation--Rural Fire Permit (y/n)					
Vegetation--Forest Danger					
Vegetation--Grassland Danger					
Vegetation--Scrubland Danger					
Vegetation--BUI					
Vegetation--DC					
Vegetation--DMC					
Vegetation--FFMC					
Vegetation--FWI					
Vegetation--ISI					
Vegetation--Wind Speed (km/hr)					
Vegetation--Wind Direction					
Vegetation--Rainfall (mm)					
Vegetation--Humidity (%)					
Vegetation--Temperature					

Appendix E—Fire Cause Categories by Organization (page 1 of 3).

Fire Cause Categories in SMS		**Annual Returns Form**	**DOC Record of Fire**	**NZDF**	**NZ Forest Service**
Deliberately Lit Fire		Road Traffic	Picnickers/Campfires	unknown	Escape of prescribed fire
	Unlawful	Tractors and Motor Vehicles	Motor Vehicles		Escape of non-prescribed fire
	Lawful	Railways	Smoking/Matches		Campfire
	Legality not known	Hunters (camp fires, etc)	Hunters		Children
	Suspicious	Picnics	Railways		Hunters
	Controlled burn, land clearning fire	Smokers	Burn breakaway--authorised		Rail
	Not classified above	Land Clearing	Burn breakaway--unauthorised		Sawmill
Reckless		Incendiary	Chainsaws		Cigarettes
	Reckless act	Industrial (sawmill, logging, etc)	Tractors/Other Machinery		Miscellaneous
	Reckless act with fireworks	Chainsaws	Arson/Incendiarism		Unknown
	Not classified above	Miscellaneous	Other		
Carelessness with Heat source		Unknown	Unknown		
	Careless disposal--cigarettes, ashes, embers				
	Unattended/asleep kitchen; cooking fires				
	Inadequate control--oepn fires/bonfires				
	Heat source too close to combustibles				
	People playing with heat soures				
	People impaired by drugs or alcohol				
	People otherwise imparied: unconscious, mental/physical				
	Not classified above				
Carelessness with Material Ignited					

	Flammable liquid/gas spilled or accidentally released				
	Improper fuelling techniques--vehicles, saws,petrol motors				
	Flammable liquid used to kindle, wash, clean, paint				
	Improper container				
	Combustible placed too close to heat source				
	Improper storage procedures				
	People playing with combustibles				
	Not classified above				
Mechanical Failure Malfunction					
	Part failure, leak, or break				
	Automatic control failure				
	Short circuit, earth fault				
	Other electrical failure				
	Lack of maintenance				
	Hydraulic line not tight				
	Backfire				
	Not classified above				
Design, Construction, Installation Fault					
	Design deficiency				
	Construction deficiency				
	Installed too close to combustibles				
	Other installation deficiency				
	No spark arrester/improperly installed				
	Not classified above				
Operating Deficiency					

	Collision, overturn, knockdown				
	Accidentally turned on/not turned off				
	Equipment unattended				
	Equipment overleaoded				
	Failure to clean				
	Improper startup/shutdown procedure				
	Equipment used for purpose not indended				
	Equipment not being operated properly				
	Not classified above				
Extreme Conditions					
	High wind				
	High water/floods				
	Lightning				
	Solar/sun				
	High temperature				
	Not classified above				
Other Cause					
	Animal				
	Rekindle from previous fire				
	Exposure fire				
	Failure to use ordinary care				
	Friction				
	Pyrophoric				
	Spontaneous Ignition				
	Unknown				
	Unable to classify				
Information Not Recorded					
Incidents Not Completed					

Appendix F— US Forest Service Wildfire Report (page 1 of 2).

USDA - Forest Service

INDIVIDUAL WILDLAND FIRE REPORT

(Ref. FSH 5109.14)

1. Fire Name	2. Local Fire Number (Local use only)

3. Location	4. Township	Range	Section	Sub-section	Principal Meridian

IDENTIFICATION

5. Region	6. Forest	7. District	8. Fire Number	9. Protecting Agency at Origin	10. Ownership at Origin	11. State at Origin	12. County at Origin	13. Fire Mgnt Zone

OCCURRENCE

14. Point of Origin		15. Time of Ignition				16. Time of Discovery			
Latitude	Longitude	Mo.	Day	Year	HHMM	Mo.	Day	Year	HHMM

17. Detection Method	18. Statistical Cause	19. General Cause	20. Specific Cause	21. Class of People

ACTION

22. Initial Strategy: ☐ Suppression ☐ Wildland fire used for resource benefits.

23. Escaped Fire: ☐

24. Time of Initial Action				25. Time Final Suppression Strategy Attained				26. Time Fire Out			
Mo.	Day	Year	HHMM	Mo.	Day	Year	HHMM	Mo.	Day	Year	HHMM

	Resource Type / Agency Group (F or C) / Quantity	Resource Type / Agency Group (F or C) / Quantity	Resource Type / Agency Group (F or C) / Quantity
27. Forces Used:	/ /	/ /	/ /
Up to Time of	/ /	/ /	/ /
Attainment of	/ /	/ /	/ /
Initial Strategy	/ /	/ /	/ /
or Escape	/ /	/ /	/ /

DESCRIPTION					
28. Estimated FS FFF Cost (whole dollars)	29. FS Acres (All Forests) .	30. Non-FS Acres Protected by FS .	31. Non-FS Acres Not Prot by FS .	**Total Acres** .	32. Acres Managed for Resource Benefit .

33. FMZ NVC/ Acre ($)	34. Fire Intensity Level	35. Rep Weather Station	36. NFDRS Fuel Model	37. Cover Class	38. Slope Pct	39. Aspect	40. Elevation (feet)

OPTIONS						
41. Special Codes	____/______	____/______	____/______	____/______	____/______	____/______
	____/______	____/______	____/______	____/______	____/______	____/______

42. Remarks

43. Submitted by:	44. Date	45. Approved by:	46. Date

SUPPLEMENT FOR LARGE FIRE ACRES BURNED							
47. Prot Agency	48. FS Unit	49. Land Ownership	50. Acres	47. Prot Agency	48. FS Unit	49. Land Ownership	50. Acres
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___
________	_____/_____	_________	________.___	________	_____/_____	_________	________.___

FS-5100-29 (xx/98)

Appendix G— US National Park Service Wildfire Report Form (page 1 of 3).

NATIONAL PARK SERVICE EDITED VERSION

UNITED STATES DEPARTMENT OF THE INTERIOR

DI--1202, INDIVIDUAL FIRE REPORT

1. STATUS CODE ___ 2. REPORTING AGENCY _3 3c. YEAR ___ ___ ___ ___ 3d. FIRE NUMBER ___ ___ ___ ___ ___ ___ ___

4. FIRE TYPE ____ PROTECTION TYPE ____ 5. GENERAL CAUSE ____ SPECIFIC CAUSE ____ ____ 6. PEOPLE ____

8. STATISTICAL DATA

8a. STATE	8b. OWNER	8c. VEGETATION	8d. ACRES BURNED
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___
_____ _____	_____	_____	___ ___ ___ ___ ___ ___ ___.___

9. AGENCY DATA

9a. FIRE NAME ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

9b. AREA NAME ___ ___ ___ ___

9f. OWNER ____

9g. FY. YR. ____

9h. FISCAL DATA ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

9j. PROBLEM CLASS ____

9k. COMPLETE 1 OF 3 (L / L; T / R / S / M; OR UTM)

LATTITUDE _____ _____: _____ _____: _____ _____:

LONGITUDE ___ ___ ___: ___ ___: ___ ___:

TOWNSHIP _____ _____ _____ _____ RANGE ____ ____ ____ ____

SECTION ____ ____ MERIDIAN ____ ____

UTM Z ___ ___ E ___ ___ ___ . ___ ___ N ___ ___ ___ ___ . ___ ___

10. SUPPRESION DATA

	DATE	TIME	TYPE	AMOUNT	ACRES
10a. DISCOVERY / START	_ _ _ _	_ _ _ _	_ _		___ ___ ___ ___ ___ ___ ___. ___ ___
10b. INITIAL ATTACK	_ _ _ _	_ _ _ _	1 2 3 4 _ _ _ _	1 2 3 4 _ _ _ _ _ _ _ _	___ ___ ___ ___ ___ ___ ___. ___ ___

10c. CONTROL/COMPLETE	_ _ _ _ _	_ _ _ _ _		
10d. DECLARED OUT	_ _ _ _ _	_ _ _ _ _		

11. SITE DATA

11a. TOPOGRAPHY _____	11d. ELEVATION ___	11h. BURNING INDEX ___ ___ ___
11b. ASPECT _____	11e. STATION ___ ___ ___ ___ ___ ___	11i. ADJ CLASS ___
11c. SLOPE _____	11f. MSGC ___ ___ ___ ___	

12. PREVENTION DATA

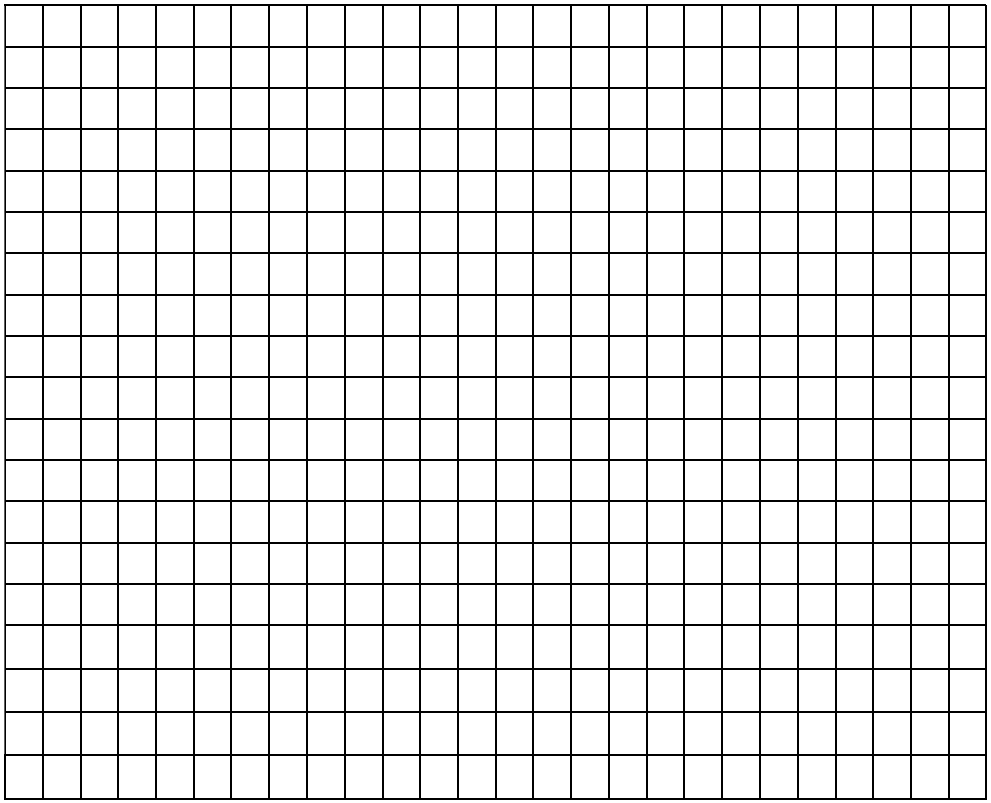
12k. DAY OF WEEK _____ 12L. WAS FIRE INVESTIGATED (Y / N) _____ 12m. FIRE CAUSE SUSPECT, KNOWN OR _____

12n. SUSPECT = RESIDENT. TRANSIENT OR UNKNOWN (R / T / U) _____ UNKNOWN (K / U)

NOTE: If you use 2 through 9 for "General Cause" and 30 for "Specific Cause" in Block #5, please explain the cause in general terms in the "Remarks" section.

13. PRESCRIBED FIRE DATA

13c. PLOT OBJ ___ ___	13f. FUEL MODEL ___ ___	13m. PNF COMPLEXITY
13d. FIRING TYPE ___ ___	___ ___	ESCAPE _____ DURATION _____
13e. COST / ACRE	12l. PROJECT # ___ ___ ___ ___	VALUES _____ AIR QUAL. _____
___ ___ ___ ___ . ___ ___		FUELS / BEHAV. _____



LOCATION PLAT
SCALE

____ " = 1 MILE

Mark point of origin
with red "X" .

Remarks: