

RURAL FIRE RESEARCH Highlights 2015



Forest & Rural Fire Association of New Zealand annual conference
Blenheim, 4-5 August 2015

Overview

- **Theme 1: Managing emerging risks**
- **Theme 2: Enhanced community resilience**
- **Theme 3: Use of fire as a tool**
- **Theme 4: Improving safety and productivity**

- **Theme 5: Economics of rural fire**

Project highlights from within each theme.



Theme 1. Managing emerging risks

Development or improving risk assessment tools to better inform fire management strategies



Current projects include:

- 1. Fire behaviour experiments in wilding pines**
2. Climate variability and fire risk
- 3. Update section 10 of the Fire Management Handbook**
- 4. Twizel and Onamalutu Wildfires – use of Prometheus**

Theme 1. Managing emerging risks

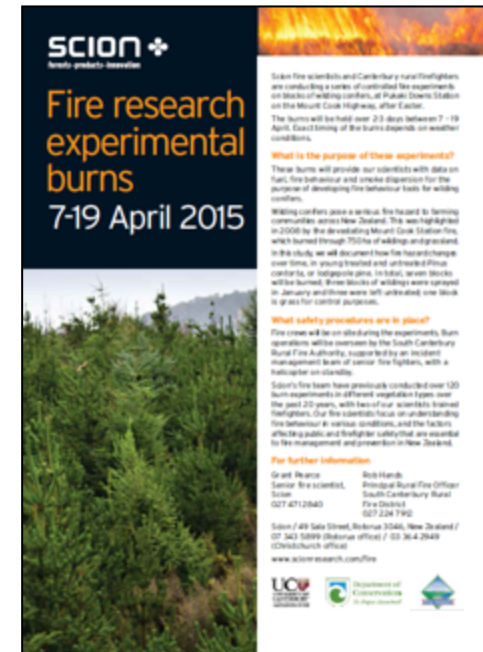
Wilding fire hazard


Conducting experimental burns in wilding pines

Why: Current models do not represent this fuel

When: Initially targeted March 2015, but:

- Driest summer in a decade
- Prohibited fire season for area
- Significant wildfire at Twizel
- So re-targeted early April (post Easter), but:
 - Too wet! (Rainfall: Jan. 10 mm, Feb. 27 mm, **Mar. 59 mm, Apr. 102 mm**)
 - Seasonal change to cooler moister conditions, shorter days
- New target, Sept-Nov 2015 (spring)



SCION 
Innovate. Predict. Sustain.

Fire research experimental burns

7-19 April 2015

SCION fire scientists and Canterbury rural firefighters are conducting a series of controlled fire experiments on blocks of wilding pines, at Pukekohe Station on the Mount Cook Highway, after Easter. The burns will be held over 2-3 days between 7 - 19 April. Exact timing of the burns depends on weather conditions.

What is the purpose of these experiments?
These burns will provide our scientists with data on fuel, fire behaviour and smoke dispersion for the purpose of developing fire behaviour tools for wilding control.

Wilding conifers pose a serious fire hazard to farming communities across New Zealand. The well-known 2008 fire at the devastating Mount Cook Station fire, which burned through 750ha of wilding pine stands, is the focus of this study. We will document how the landscape changes over time, in young treated and untreated pine stands, and in adjacent pine, or forest, so we can better understand the fire behaviour in various conditions, and the factors affecting public and firefighter safety that are essential to the management and control of fire in New Zealand.




What safety provisions are in place?
Fire crews will be on site during the experiments. Burn operations will be overseen by the South Canterbury Rural Fire Authority, under the direction of an incident management team of senior fire fighters, with a helicopter on standby.

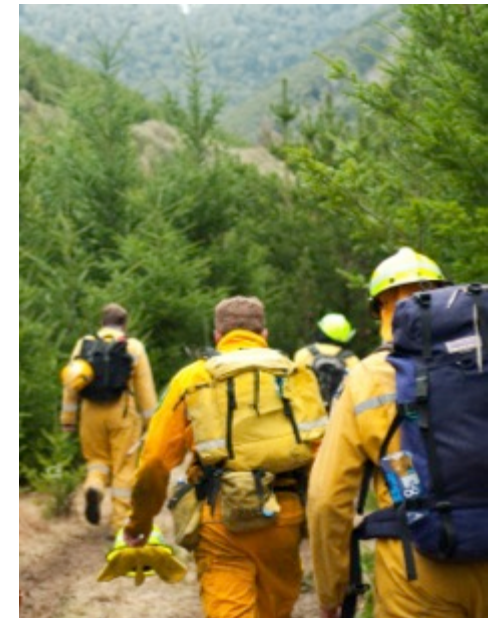
SCION's fire team have previously conducted over 120 burn experiments in different vegetation types over the past 20 years, with help of our scientists trained firefighters. Our fire scientists focus on understanding fire behaviour in various conditions, and the factors affecting public and firefighter safety that are essential to the management and control of fire in New Zealand.

For further information:

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www.scionresearch.com/fire



Where: Pukaki
Downs Station,
near Twizel

Phase 1:

Young, sparse
wildings



Future: Other ages
and densities



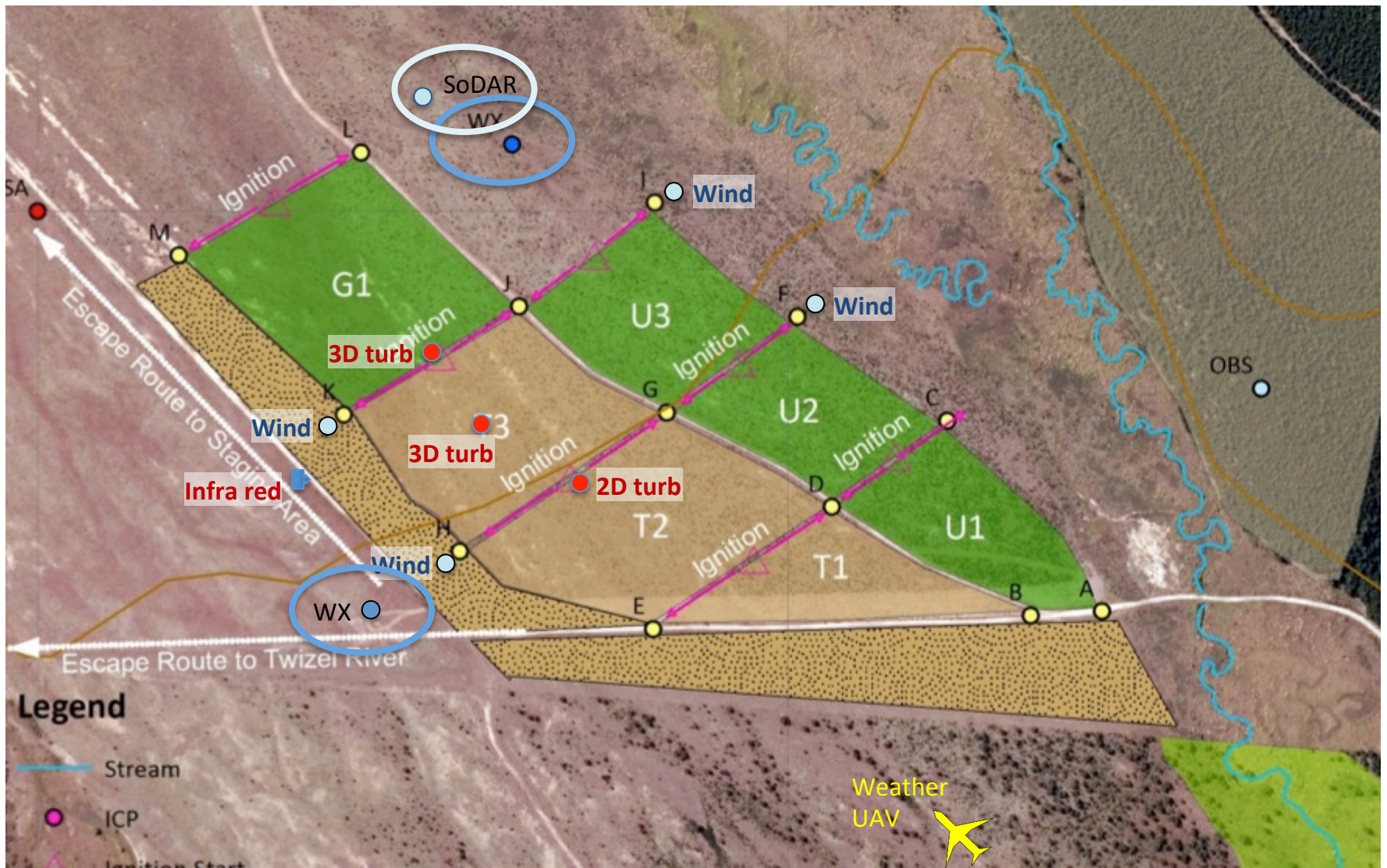
8ha site, 4ha sprayed



7 burn plots:

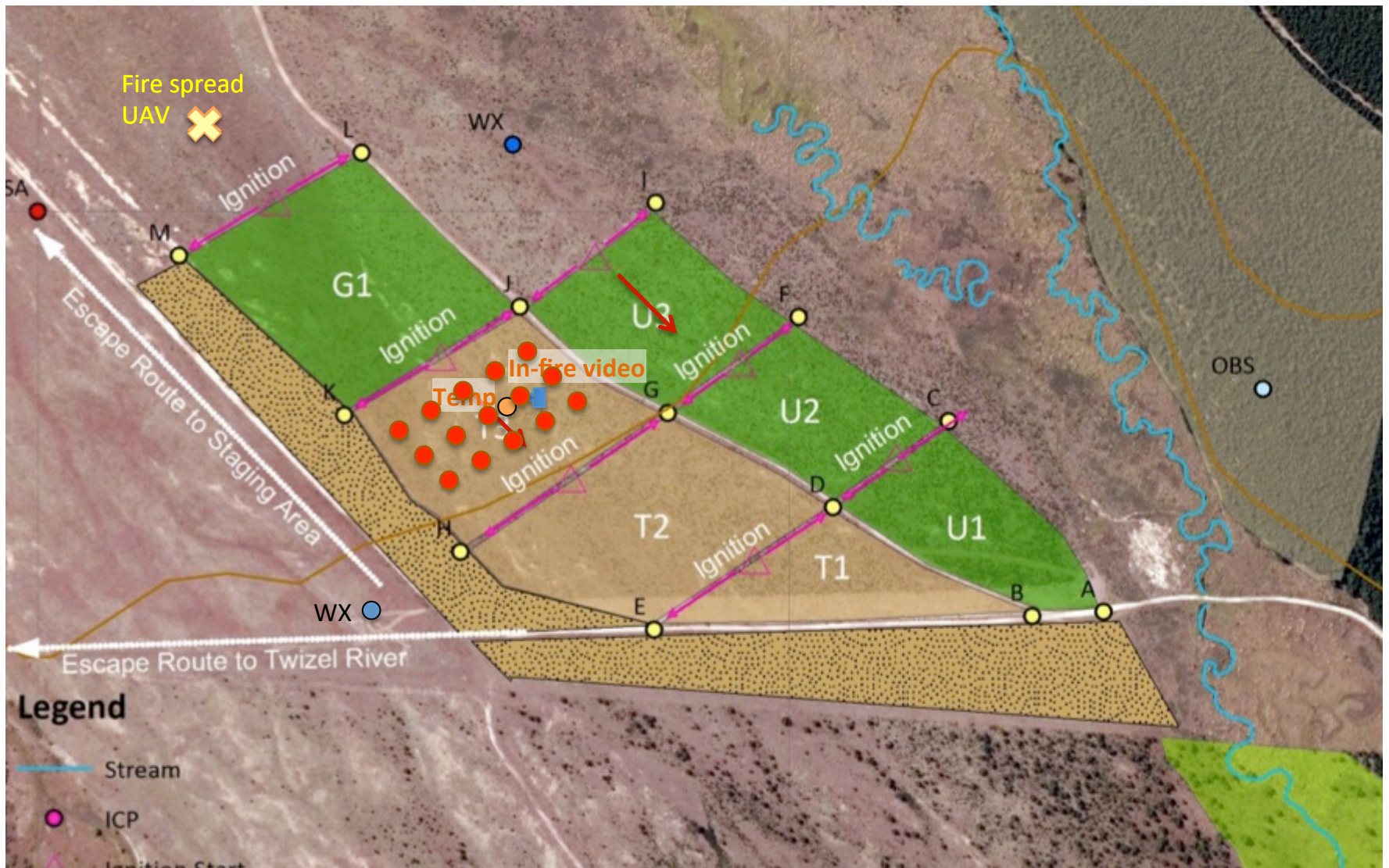
3 sprayed (red phase), 3 untreated (green/healthy), 1 grass (control)





Weather data collected:

2x weather stations, 1x SoDAR, 4x WS&WD grid, 3x windsonics, 1x fixed wing UAV,



Fire behaviour data collected:

42x ROS loggers, quad UAV (IR), 2x Thermocouple towers, 2x In-fire cameras,



Interim results



- Age disks collected
 - average 4 - 5 years with the some 3, 6 and 7 y.o. trees
- Biomass collected - under analysis
- Non-destructive results:

Treated:

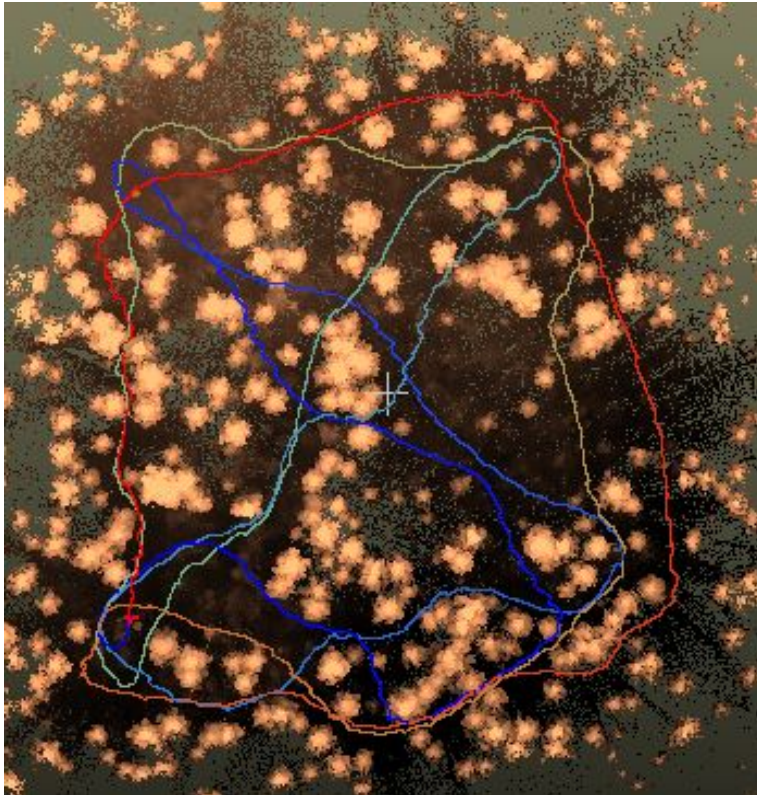
- **Count:** 3,700 trees/ha
- **Avg. Height:** 1.6m
- **DBH:** 11mm
- **Basal diameter:** 40mm

Untreated:

- **Count:** 6,000 trees/ha
- **Avg. Height:** 1.7m
- **DBH:** 11mm
- **Basal diameter:** 34mm

Remote sensing images

Ground LiDAR cloud collected



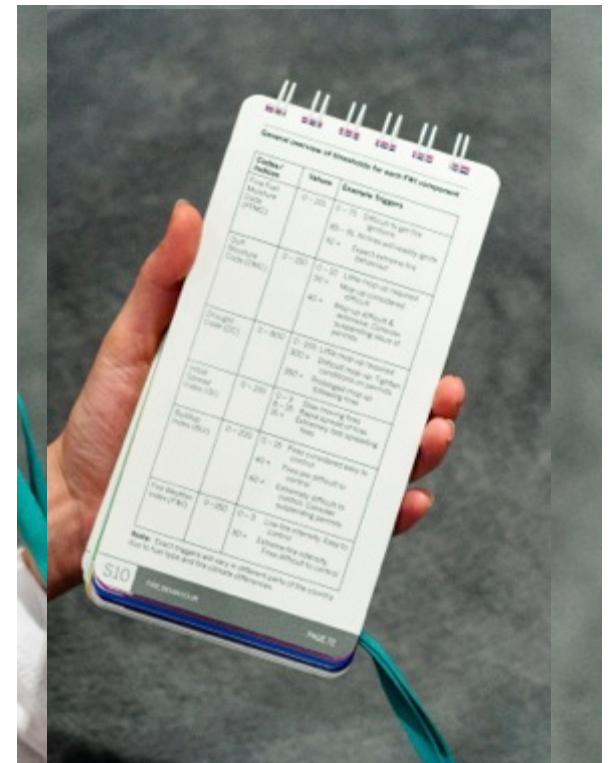
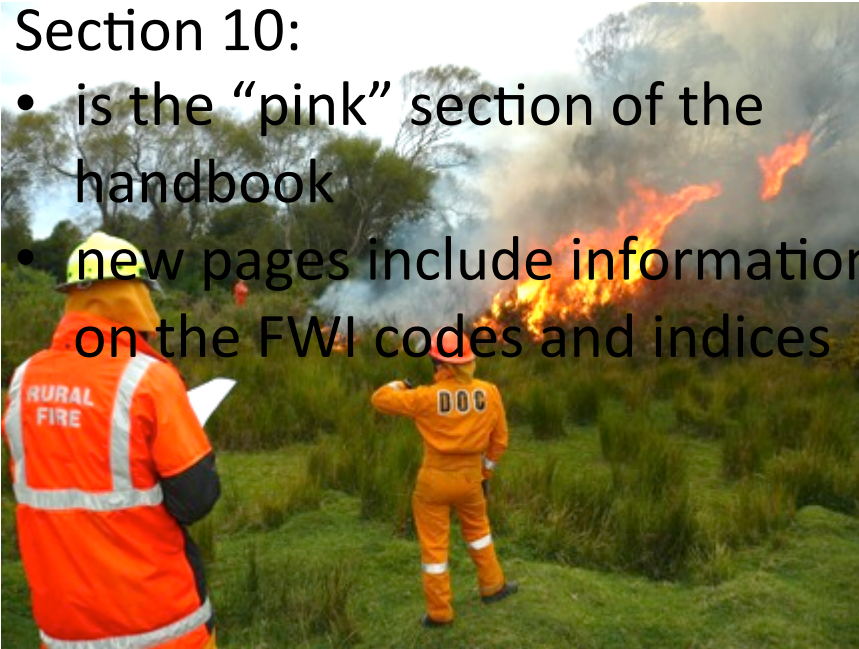
Theme 1. Managing emerging risks

Rural Fire Management Handbook

- Updated Section 10.0 Fire behaviour
- Based on same information as the orange Fire Behaviour Manual, just condensed down

Section 10:

- is the “pink” section of the handbook
- new pages include information on the FWI codes and indices



Using the fire behaviour section

It's a step by step process:



Wind (pages 75, 76, 77):

1. I don't have a Kestrel so can't measure WS.
2. I have a Kestrel, but need to adjust the WS.
3. Work out how fast the fire is likely to travel. Need to know FFMC & WS.

Fuels (pages 78, or 79, or 80):

4. How much fuel there is to burn. Need to know what the fuel type is, and either BUI or height.

Rates of spread (pages 81, 82, 83, 84):

5. How fast a fire will travel on flat terrain. You need to know what the fuel type is & use ISI, worked out in step 3.
6. How fast a fire will travel on slope. You need ROS from step 5. Use the tables or use rule of thumb on page 84.

Fire intensity (page 85 – 91):

7. How hot the fire is. Use the simple formula on page 85 & ROS and fuel load worked out in steps 4 & 5. Or,
8. Use the table that spans pages 87-89.
9. Or, if you have visual observations of flame length, use table on page 90.

Suppression guides (page 91):

10. Suppression limits in relation to calculated fire intensity.

Fire danger classes (pages 92-96):

11. Working out the fire danger class (L, M, H, VH, E) for various fuel types.
Or,
12. A guide to fire fighter safety, with a description of the likely fire intensity and implications for suppression.

Fire shape and size (page 97): use the formulas.

Fire behaviour observation sheet (page 98): use this to record fireline obs.

Theme 1. Managing emerging risks

Wildfires

Wildfire spread and firebreak effectiveness for the Old Glen Lyon Rd (Twizel) wildfire using Prometheus



What is Prometheus?

Software that simulates fire spreading across the landscape

- Combines weather, fuel types, topography and fire behaviour models
- Developed in Canada and re-developed using fire behaviour models for NZ fuel types
- Cuts down the time predicting fire growth manually

Can be used for:

- Pre-planning
- Wildfires
- Post-fire assessment

3 NZ training courses run in Sep/Oct. 2014

- 47 people trained up



Pre-FRFANZ

Prometheus Refresher Workshop

Tue. 4 Aug. 2015

Workshop 1: Prometheus Refresher

0900 – 1200 hrs

Presenter: Veronica Clifford (Scion)

A refresher for those who attended the 2010 or 2014 NZ Prometheus Courses. Practise with new fire runs and learn how to use the new R clipping tool



Twizel wildfire, 4 Jan. 2015



Close call for camp ground & town

Distance from POI: 2 km to camp ground (fire stopped < 0.5 km)

2.7 km to first properties (fire stopped < 0.5 km)

3.5 km to town (fire stopped < 1.5 km)



Fire environment

- **Ignition occurred:** 4 Jan 2015 @ 1714 hrs
- **Weather**
 - **Nearest weather station** was the Pukaki Aero Raws
 - **Daily fire weather indices** for the 4th January – considered extreme
 - FFMC 96; DMC 35; DC 275; ISI 12.9; BUI 54; FWI 27.6
 - **Fire danger:** VH Forest; E Scrub; VH grass
- **Fuels**
 - The most dominant fuel is cured grass, some Pine stands (wildings)
 - Presence of a Lucerne paddock acting as a green fire break
- **Topography**
 - Generally flat terrain, elevation ranged from 520 m at the POI and sloped down towards Twizel at 480 m
 - Roads acting as fire breaks

1715 hrs

Ignition has taken place

Fire progression if no suppression taken

Google earth view



1815 hrs (1 hr)

Fire has reached the outskirts of Twizel town burning in Pine
Several buildings burnt over on Ostler Rd

Area: 253 ha



2000 hrs (2hrs 45min)

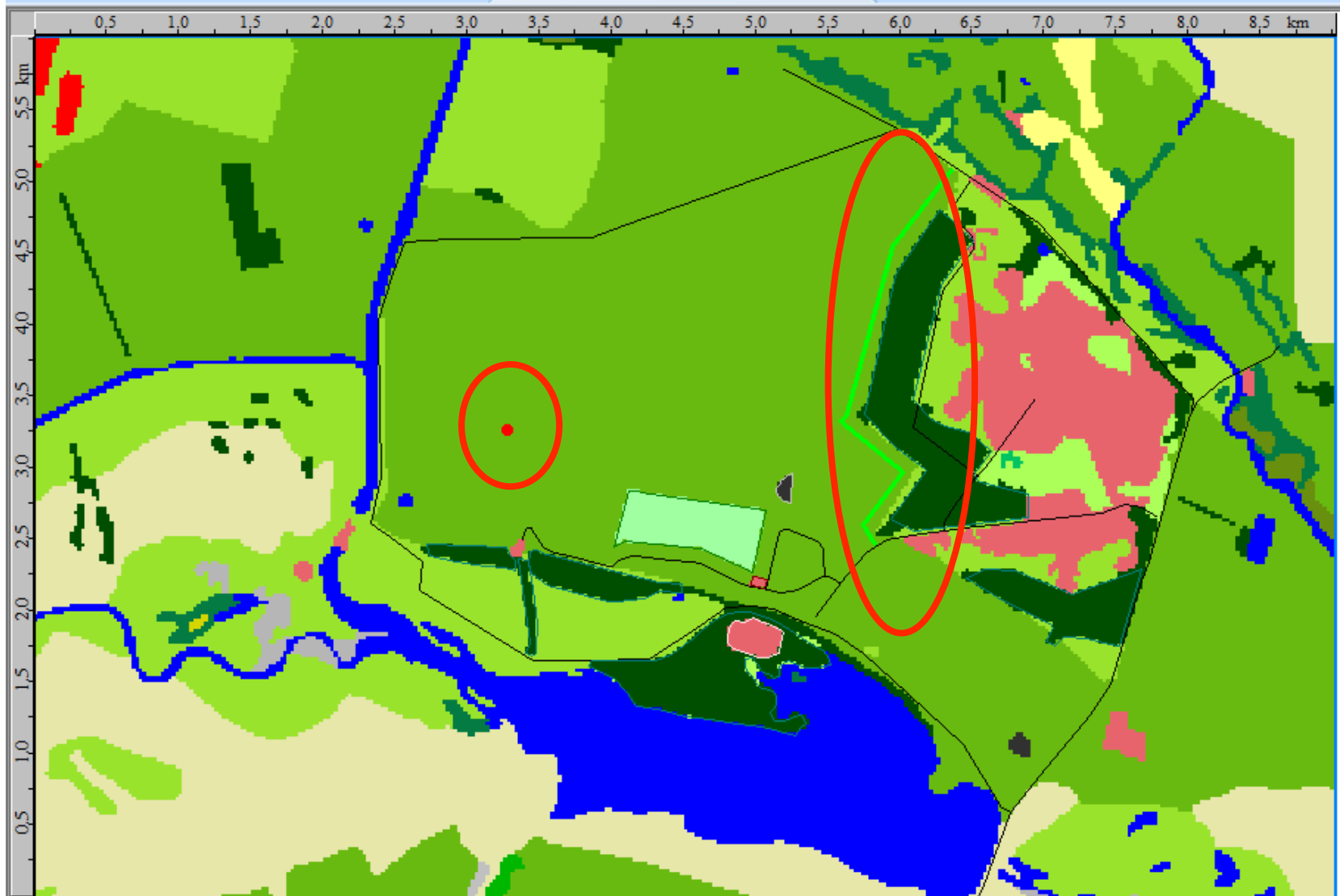
Southern flank slowly flank burns into campground
Head of fire continues in the East/South East direction

Area: 1000 ha



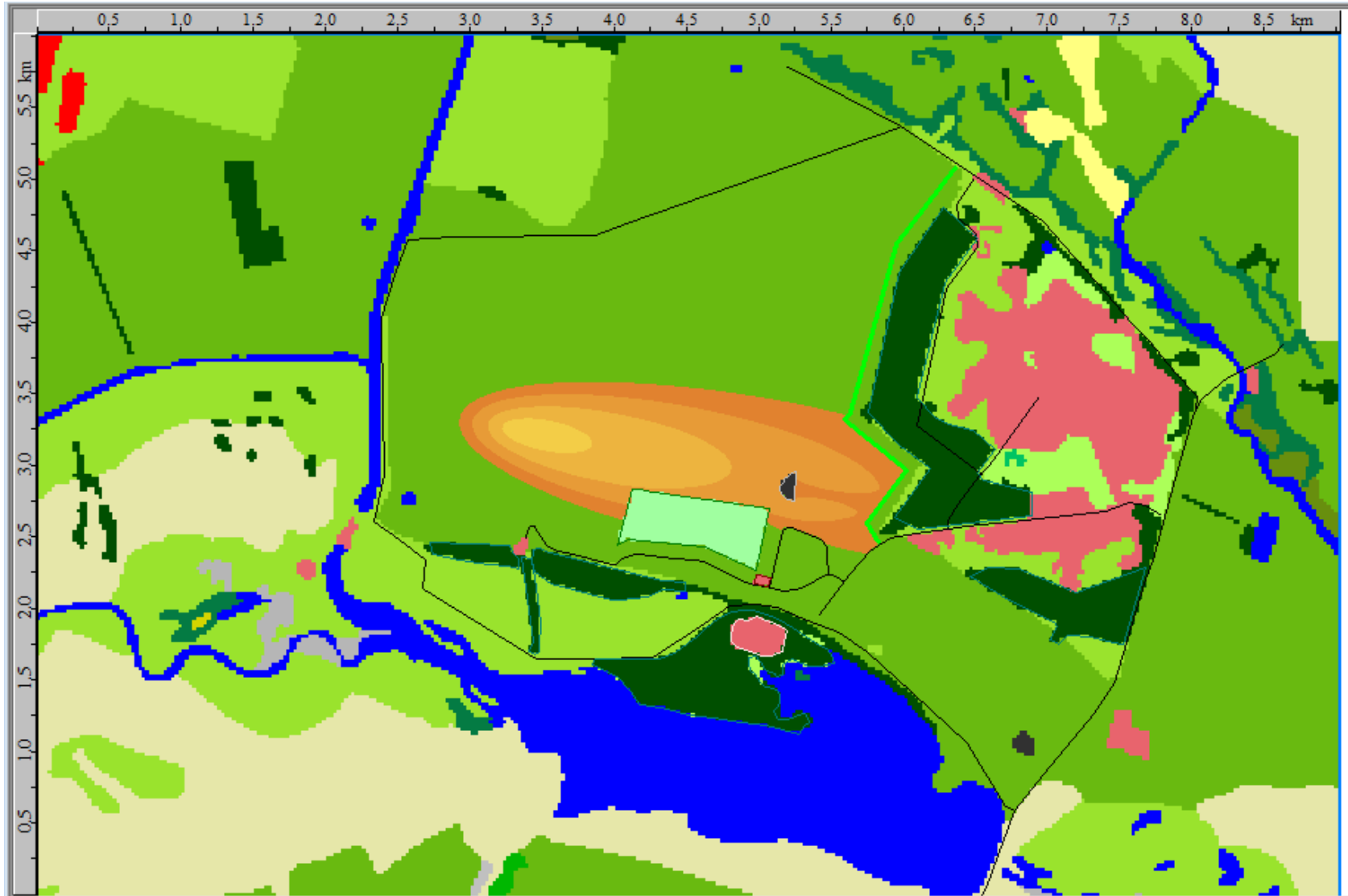
Will a 10m fuel break hold the fire?

1715 hrs



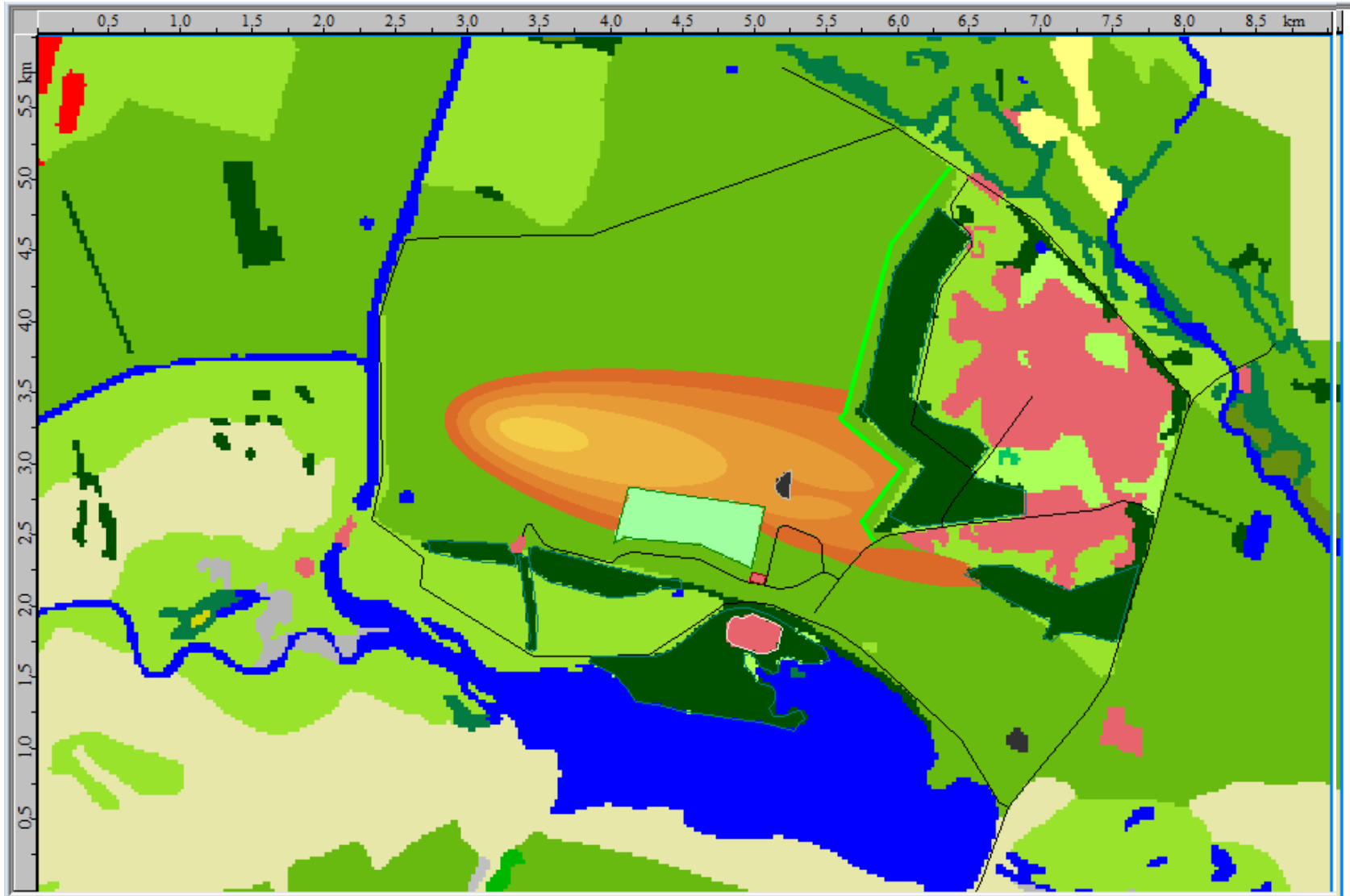
Will a 10m fuel break hold the fire?

1815 hrs (1hr since ignition)



Will a 10m fuel break hold the fire?

1830 hrs (1hr 15min)



Onamalutu Wildfire

Biggest wildfire to impact region since 2000

- 4 Feb. 2015 (23:15pm)
- Burned approx. 600ha
- 17 km perimeter to control
- Estimated cost \$1.5 million
- Devastated forest & pasture
- Main power supply threatened
- Number of properties threatened
- Some residents self evacuated
- Evacuation plan prepared
- At its height, 12 helicopters, 100 fire fighters & 1 NIMT used
- Farm outbuildings, water tanks, fencing and kilometres of piping for stock water destroyed
- **No loss of life or homes**
- Cause unknown



Fire environment





Young forestry with gorse & broom



Mature forestry – mostly radiata pruned to 6m



Mature Eucalyptus forest with gorse understory



Mature forestry with little understory



Fully cured crop stubble and slash



Un-grazed pasture grass



Fully cured standing crop



Grazed pasture

Fire environment

Weather

Nearest weather station was the Onamalutu Raws (FWSYS)

- Lat & long: -41.446370°; 173.726530°
- 10min and hourly data is available from Harvest
- Fire weather codes and indices were calculated using Scion's FWI calculator
 - using raw data from Harvest
- Onsite hourly weather readings were provided
 - Peter Gilbert, Nathan Keoghan, Mark Bryant

Daily fire weather indices for the **4th Feb**:

- FFMC 89.3; DMC 47; DC 356; ISI 18.7; BUI 71; FWI 40.3
- **Fire danger:** E Forest; E Scrub; H grass

Daily fire weather indices for the **5th Feb**:

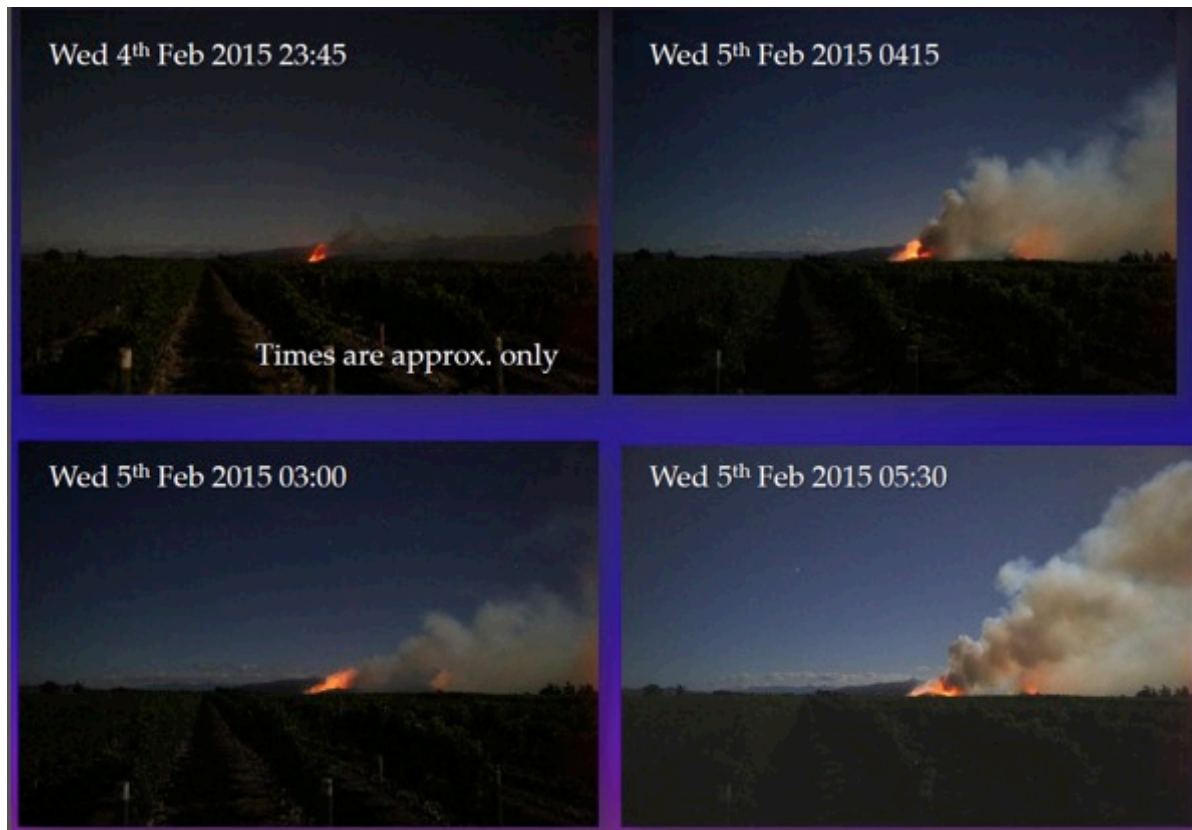
- FFMC 91.4; DMC 50; DC 363; ISI 11.0; BUI 75; FWI 29.2
- **Fire danger:** VH Forest; E Scrub; H grass

Daily fire weather indices for the **6th Feb**:

- FFMC 76.6; DMC 42; DC 363; ISI 1.3; BUI 65; FWI 4.7
- **Fire danger:** M Forest; VH Scrub; M grass

Fire behaviour

- Web camera footage - Private YouTube link of a timelapse camera
- Setup in the Stoneleigh vineyard
- Captured fire ignition and spreading
- Also significant spotfire (jumped 2.5 km)



Post burn images: areas of intense burning crown fire run & intermittent crown fires (torching)



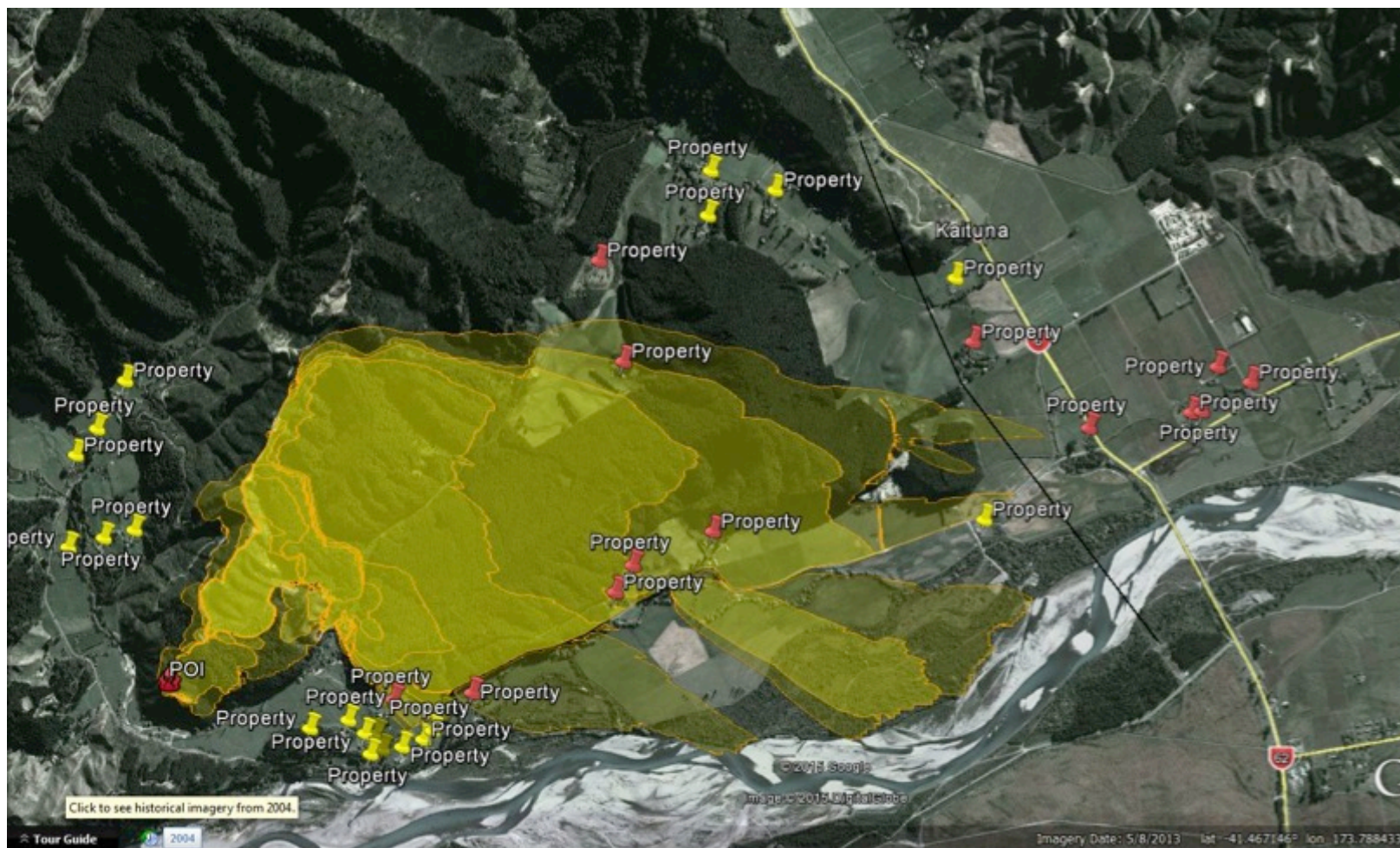
POST FIRE ASSESSMENT – without suppression

18:00 on 5 Feb. 2015 (after 17hrs & 45mins)

Six properties overtaken along Northbank road

Main power line threatened

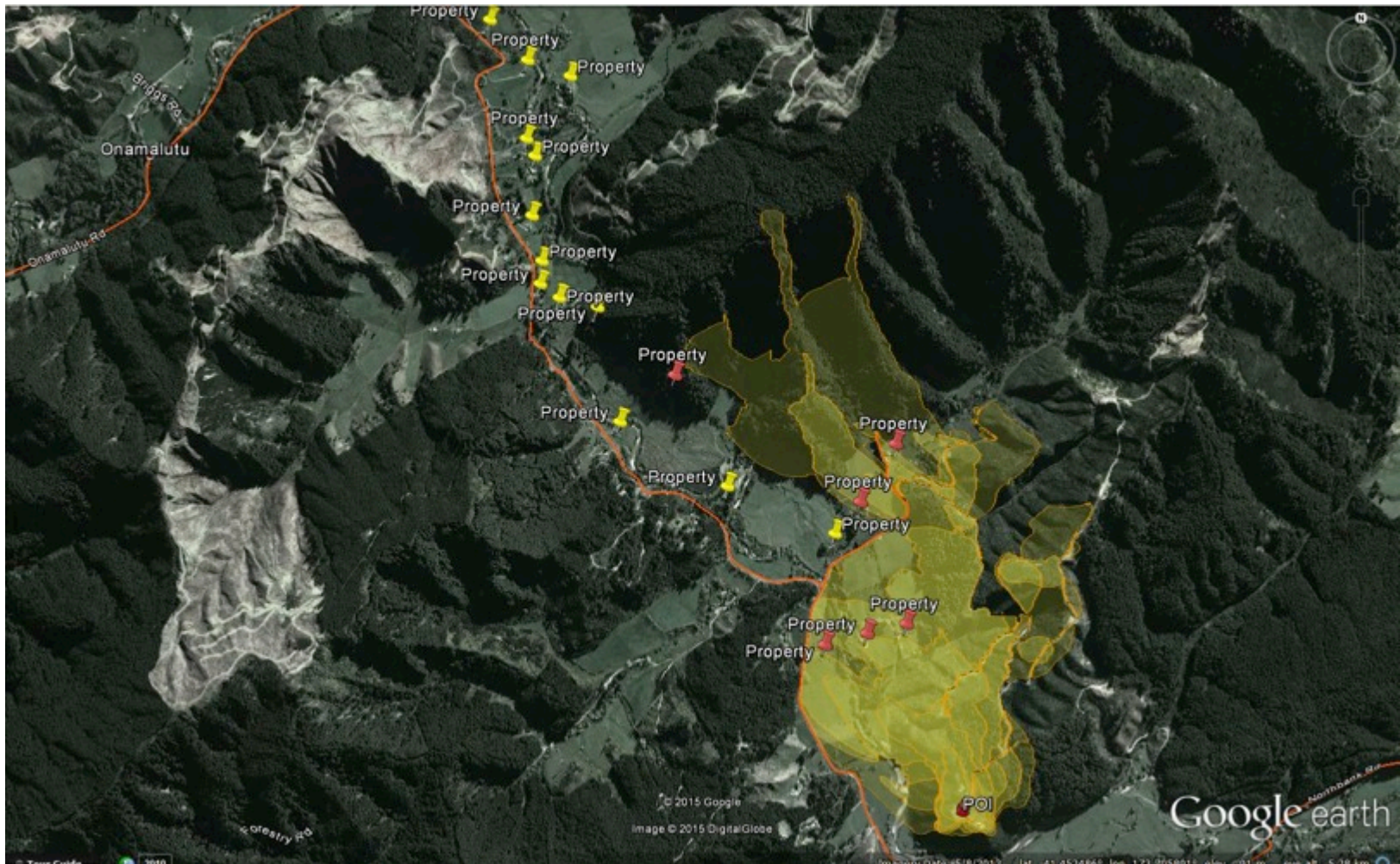
Area: 651 ha
Perimeter: 19km



EVACUATION PLANS

19:30 on 8 Feb. 2015 (3hr & 30min after a re-ignition)

Four properties have been overrun and three are threatened by flanking



Onamalutu wildfire, 4 Jan. 2015

Fire Behaviour Toolkit and Prometheus predictions used by NIMT to support:

- Fire suppression strategies & tactics
(briefings)
- Resource requirements
- Evacuation planning



Theme 2. Enhanced community resilience

Improve at-risk communities' readiness to respond to, and recover from, rural fire events

Current projects include:

1. **Effective communication**
2. Māori traditional use of fire
3. **Mapping wildfire prone areas**

Future program:

- Community resilience (fire and other hazards)
- Karikari Peninsula community case study – linked to studies of First Nations communities in Canada



Theme 2. Enhanced community resilience

Building community awareness of fire risk

What: A study to determine most effective communication strategies to educate communities about:

- Risk of wildfires
- Being prepared for a wildfire event
- How to minimise the number and impact of human-caused fires

Why: Evidence suggests that many communities are unaware of the risk wildfires pose and are ill prepared

How: Interviews and documented knowledge

Where: 3 NZ case study areas

- Nelson, Queenstown & Mahia



Pre-FRFANZ

Effective Communication Workshop

Tue. 4 Aug. 2015

Workshop 2: Effective Communication

1300 – 1600 hrs

Presenter: Lisa Langer (Scion)

Find out about the most effective methods for communicating with communities about the risk of wildfires, being prepared for a wildfire event, and how to minimise the number and impact of human-caused fires.

Evidence suggests many communities are unaware of the risk wildfires pose and are ill prepared for their occurrence. A recent Scion/BFCRC study found that the ability to effectively communicate with at-risk communities is not a simple 'one size fits all' approach.



Findings:

Available in Fire Tech Transfer Note #43:



- It's not a simple 'one size fits all' approach.
- Effective communication needs to be linked with the nature of the community you are targeting. Different messages for each audience:
 1. Never use fire ([communication on wildfire awareness & preparedness](#))
 2. Light fires for clearance ([info on fire restrictions, awareness of fire risk, prevention & preparedness requirements](#))
 3. Recreational users that tend to be seasonal and visitors, i.e. campfires ([wildfire awareness and prevention](#))
 4. For cultural purposes, i.e. cooking food ([wildfire awareness and prevention](#))
- Agencies also need careful consideration to the mode of communication
 - One-way (pamphlets, radio, etc.) [okay for awareness & preparedness](#)
 - Two-way (face-to-face) [best for fire restrictions, permit requirements, etc.](#)

Theme 2. Enhanced community resilience

Mapping wildfire prone areas

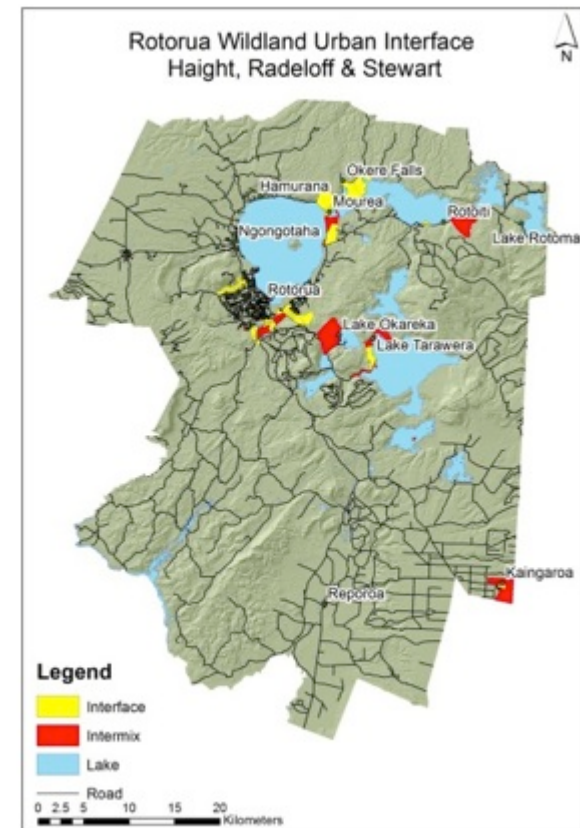
Why: Help fire managers identify areas with high wildfire risk to prioritise their activities, to reduce the chance of life or property loss.

How:

- Held a workshop with PRFOs to agree on what defines a wildfire prone area.
- Developed a two step methodology:
 1. Map of RUI: building density, distance from flammable vege, fire stations and water sources
 2. Overlay fire risk factors, e.g. fire climate, slope steepness, fire history, social networks

Where: Two pilot studies undertaken

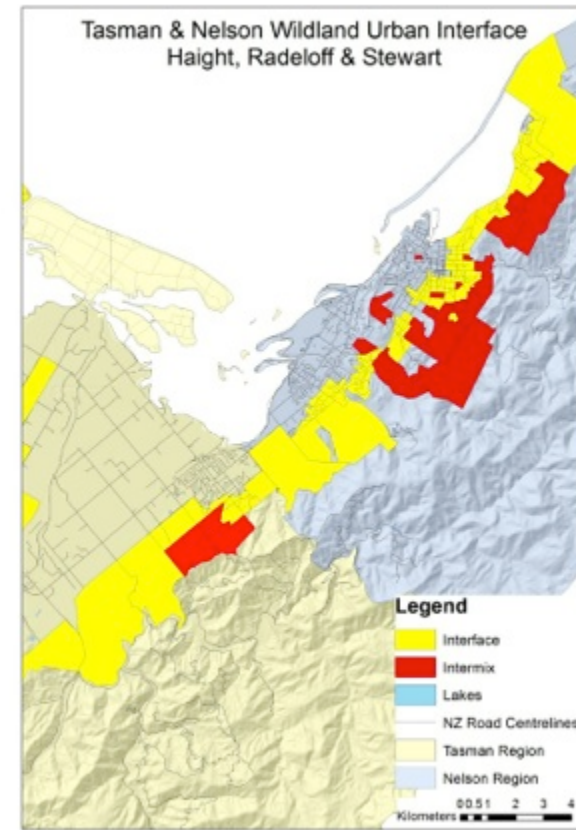
- Rotorua and Nelson



Findings

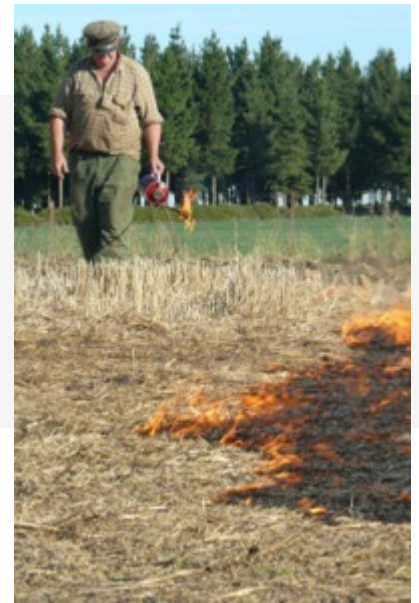
Report and recommendations available.
NZ Fire Service developing national RUI layer.

- Local not national tool
- National data layers, but important to add local knowledge
- Allows prioritisation of areas for fire risk reduction, e.g. FireSmart
- **Adds to WTA and STFMP methodologies**
 - A local STFMP project underway to develop regional fire risk mitigation plans



Theme 3. Use of fire as a land management tool

Develop knowledge and tools to support the safe and effective use of fire as a land management tool



Current projects include:

1. Development of a smoke modeling tool
2. Waihopai Valley controlled burns
3. Survey of NZ views on benefits and impacts of using fire

Future program (2016 – 2020):

- Safer & effective prescribed burning
- Fire effects in NZ ecosystems
- Smoke tools
- Improved fire incident reporting systems



Theme 3. Use of fire as a land management tool

National survey



Investigate the risks and benefits of using fire as a land management tool

Why:

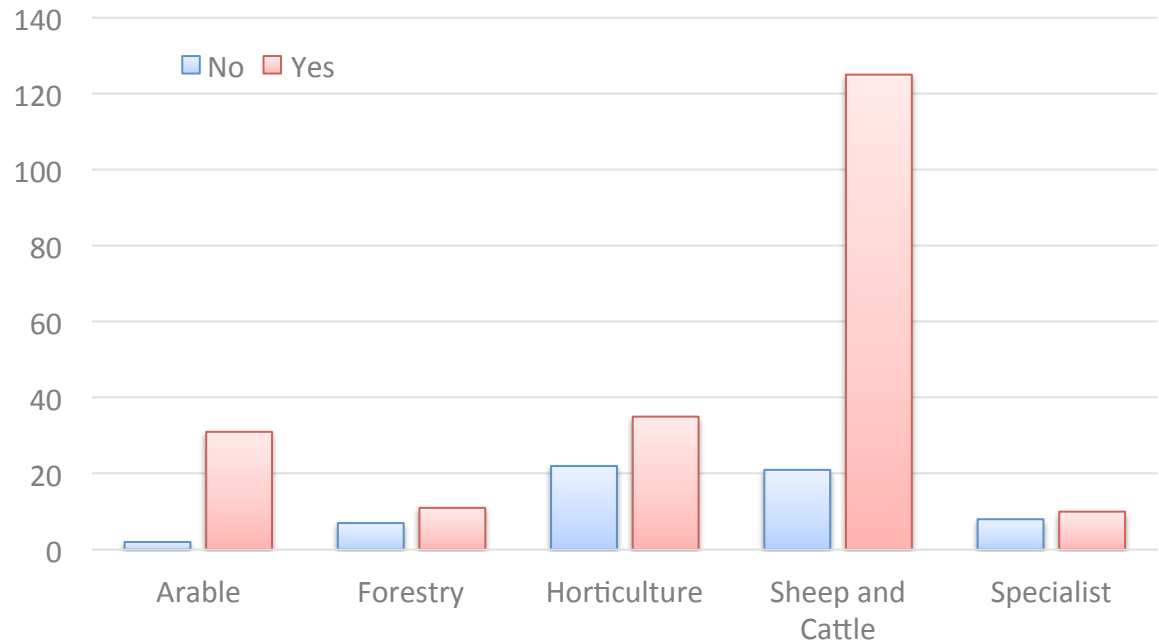
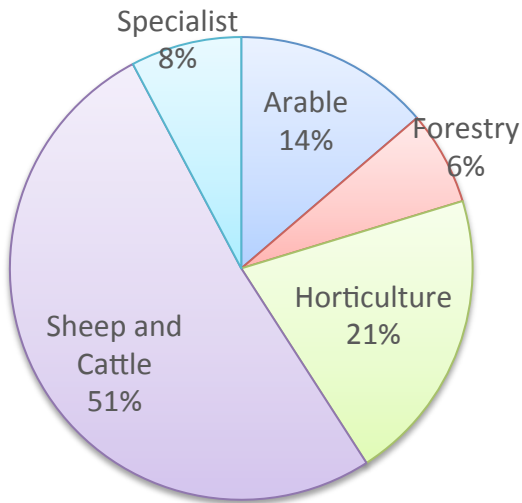
- The practise of using fire appears to be a dying art, and has received a lot of negative feedback in the media. We want to understand the positives and negatives around the use of fire.

How:

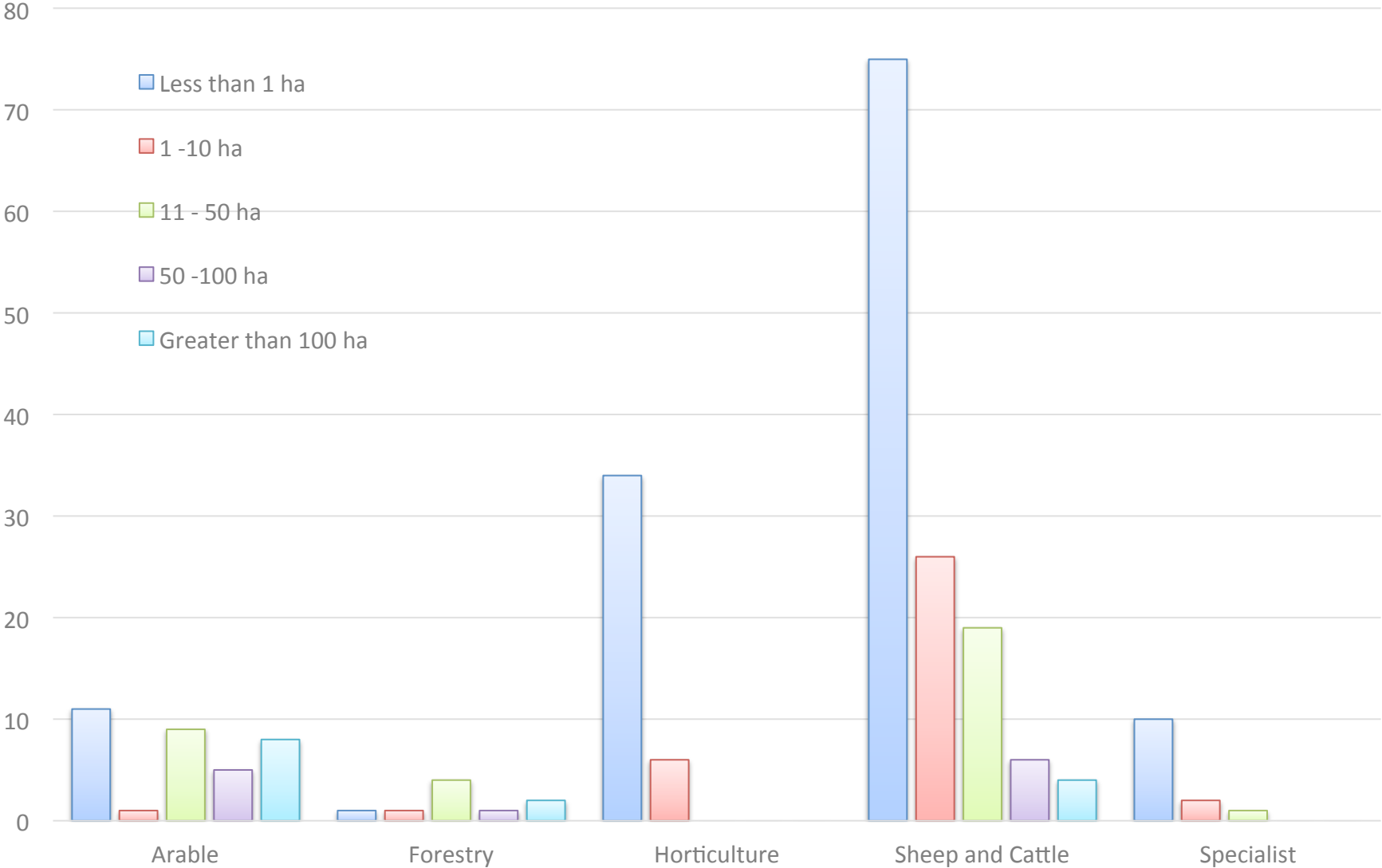
- Online survey to understand the national perspectives. Targeting:
 1. Rural productive landowners
 2. Rural residents (non-productive)
 3. Policymakers & local authorities
- A total of 56 questions were asked.
- We have finished the survey, and now work has started on the analysis.

- Marry perceptions (from the online survey) with facts (from a literature review)
- Findings to be presented at a workshop in 2016, and will help with policy making and best practise guidelines

NEW. Results:

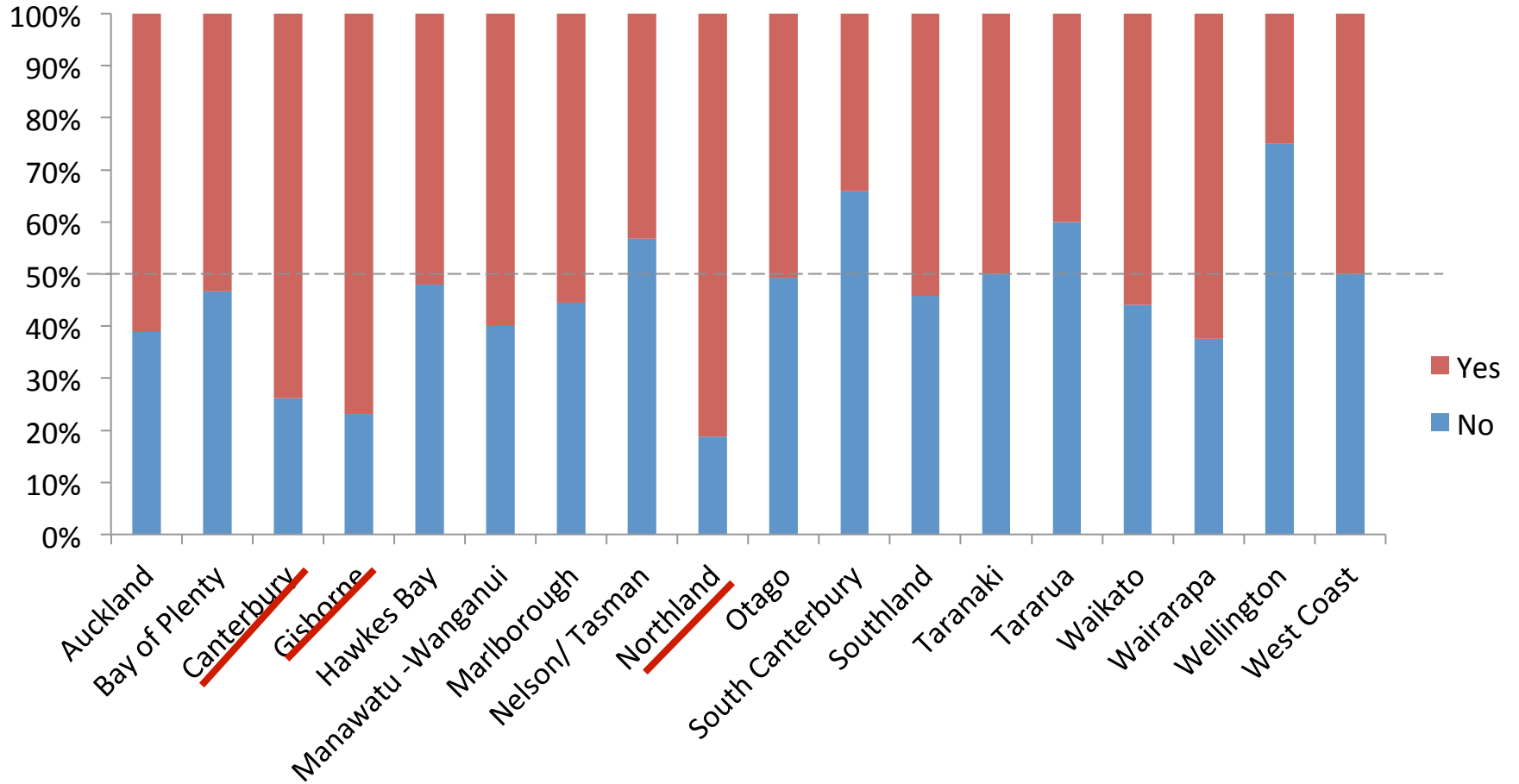


What area of land was cleared from this burn?



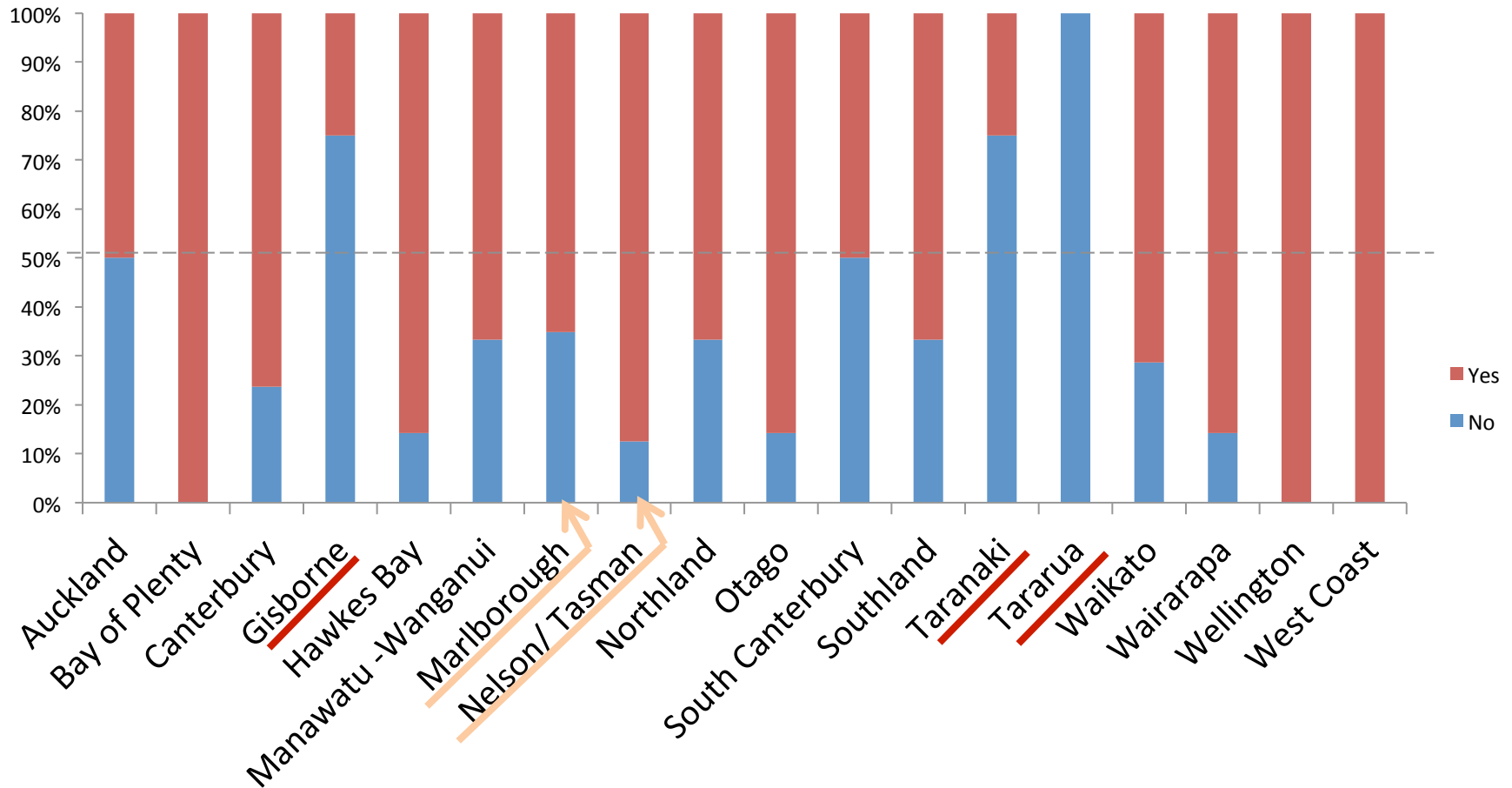
NEW

Example: Are they using fire to manage land?



NEW

Example: Are land managers adequately informed about safe and effective use of fire?



Theme 4. Improving safety and capacity

Develop tools and best practice guidelines to maximise the safety and productivity of the workforce.

Current projects include:

1. Review of fire fighter fitness guidelines
2. Hot spot detection with UAVs
3. Collection of fire fighter workload & productivity data at wildfires with ensemble helmet

Future program:

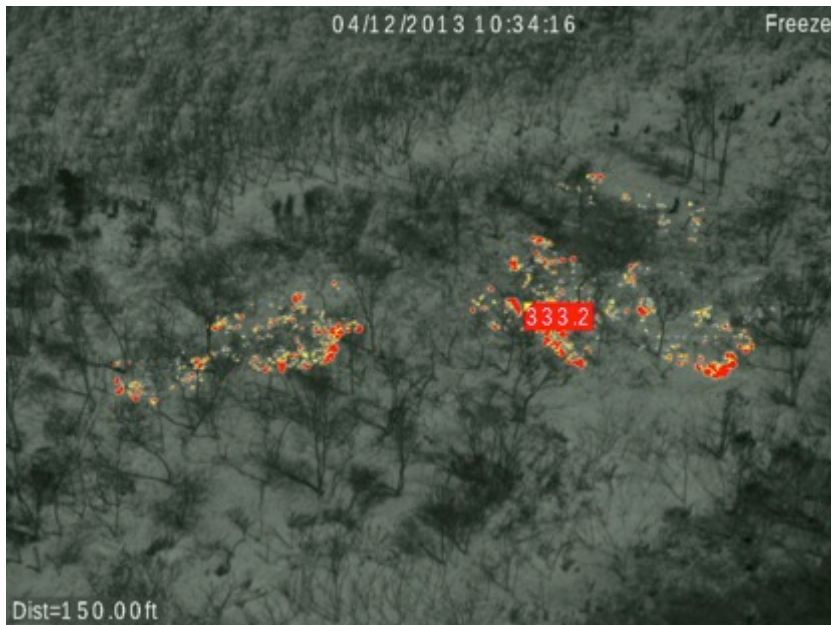
- Continue collection of workload/productivity data
- New fire suppression technologies
- Lessons learned resource
- National injury/near-miss reporting scheme for rural fire?



Theme 4: improving safety & capacity

UAVs and hot spotting

- Collaboration with Tait Communications & Uni. Canterbury
 - 4th year Computer Science Students developing software:
 - Control IR camera & UAV
 - Map hot spot locations
 - Send location information to fire fighters on ground



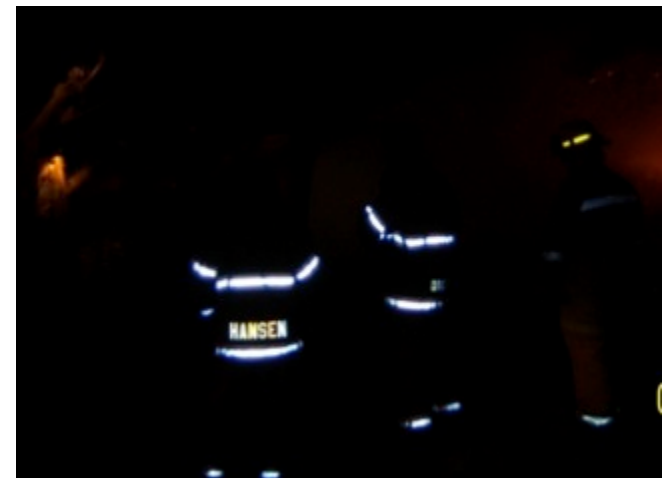
Problem: Hot Spotting & Mopping-Up

- Hotspots are burning material usually underground
 - Embarrassing if fire not fully out
 - Labour intensive, dangerous, costly
 - Crews often working through the night
 - Feeling for hotspots using their hands
 - Superheated soil
 - Hire of helicopter to fly the fire ground

Day mopping-up

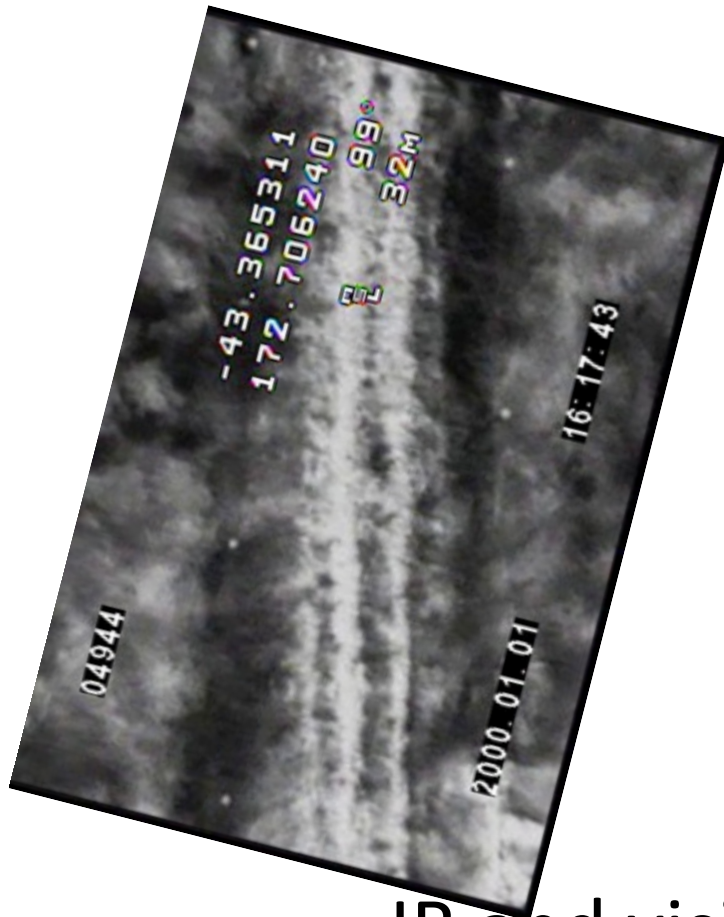
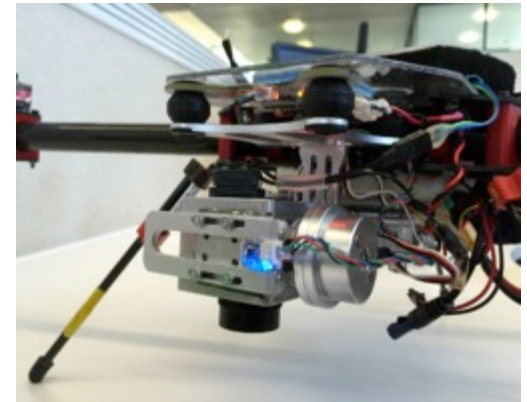


Night mopping-up



(Source: youtube Roswell Flight Test Crew)

- Low-cost FLIR camera - basic thermal imaging at low resolution



IR and visible light – Pines Beach

Progress:

- Bowl of warm water from 20m altitude
- Successful with water bowl
- Could handle high trees and 20 knot wind
- Need to try at real fires
- Continue developing “auto-pilot” and overlay on maps



Theme 5. Maximising benefits from investment

NEW

Future programme (2015 – 2020)

- Quantification of the total costs of wildfires (incl. impacts).
- Improved quantification of fire management costs, and tools for determining cost effectiveness of suppression methods / strategies.
- Economic framework to support prioritisation of expenditure across the 4 Rs (esp. benefits of Reduction over Response).
- Forecasting of future fire costs (and benefits) with land use change & climate change.
- Improved wildfire incident reporting systems (incl. use of satellite detection?), as critical input into real-time wildfire growth & smoke models

Total cost of wildfires in NZ

New NZFSC Contestable Fund project for 2015/16 (& 16/17)

Aim:

- Develop an integrated rural fire economic cost framework that describes the total costs of wildfires in NZ
 - direct, indirect and intangible costs incurred following a fire event
- Identify existing data sources and potential methodologies to estimate non-existing data
- Assess applicability of the framework
- Test using wildfire case studies (2016/17, if funded)

END

Scion's Rural Fire Research Group is New Zealand's only provider of specialist fire research expertise in NZ rural and forest landscapes.