



Wildfire Threat Analysis (WTA)

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Wildfire Threat Analysis (WTA)

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Forest Research

*Wildfire research and its impact on policy, planning and operations;
the Swinley Forest fire. Greenwich, 10 Apr 2015*

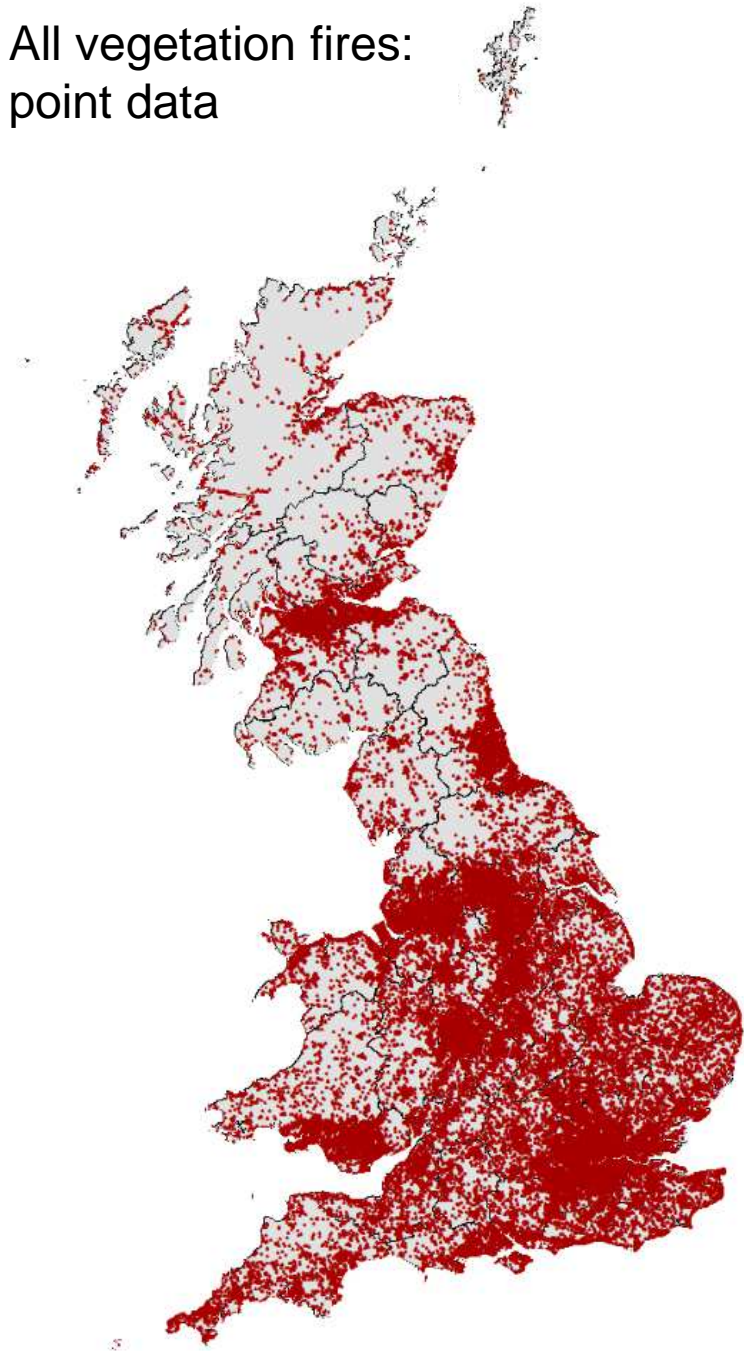
Vegetation fire in GB

- Fire Service Incident Recording System (IRS)
- 5 years for England, FY 2009/10 – 2013/14.
- 4 years for Scotland and Wales, FY 2009/10 – 2012/13
- Peri-urban

Acknowledgments:

- Data: Dept for Communities & Local Government, courtesy of Forestry Commission England
- Map: Sam Grundy, MGeog, University of Manchester.

All vegetation fires:
point data

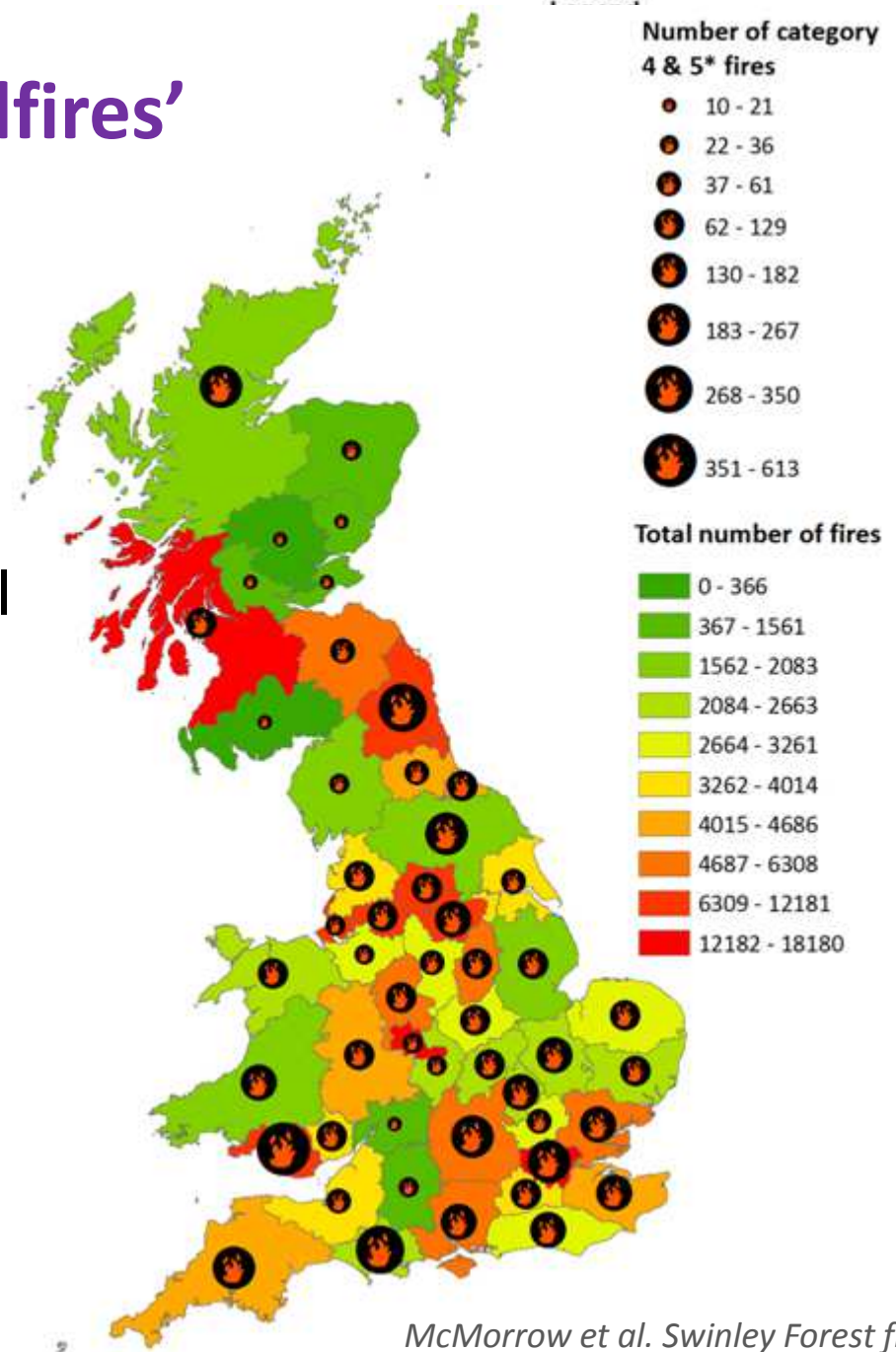


Vegetation fires vs 'wildfires'

- Shading shows all vegetation fires by Police Areas
- Symbols show large fires ('category 4 & 5'); more rural
 - ≥ 1 ha
 - ≥ 6 hours callout
 - ≥ 4 vehicles

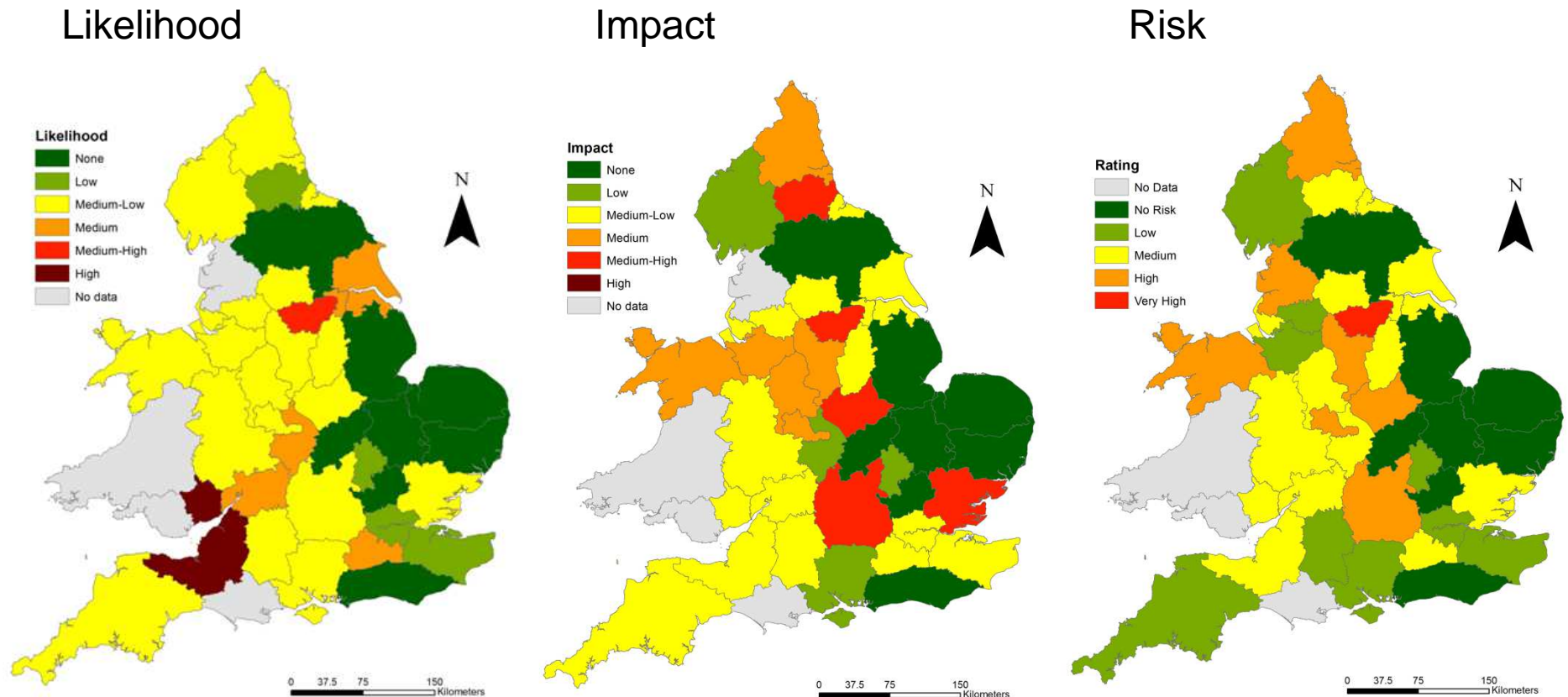
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- Data: Dept for Communities & Local Government, courtesy of Forestry Commission England
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Moorland & Forest Fire in Community Risk Registers



Acknowledgments:

- Data: online Community Risk Registers
- Map: Yongjun Wang, MSc Geographical Information Science, University of Manchester. *Preliminary results only; please do not reproduce without the author's permission*

WTA scoping study

Context: Forestry Commission England (FCE) need to manage wildfire threat to forest assets and to surrounding communities

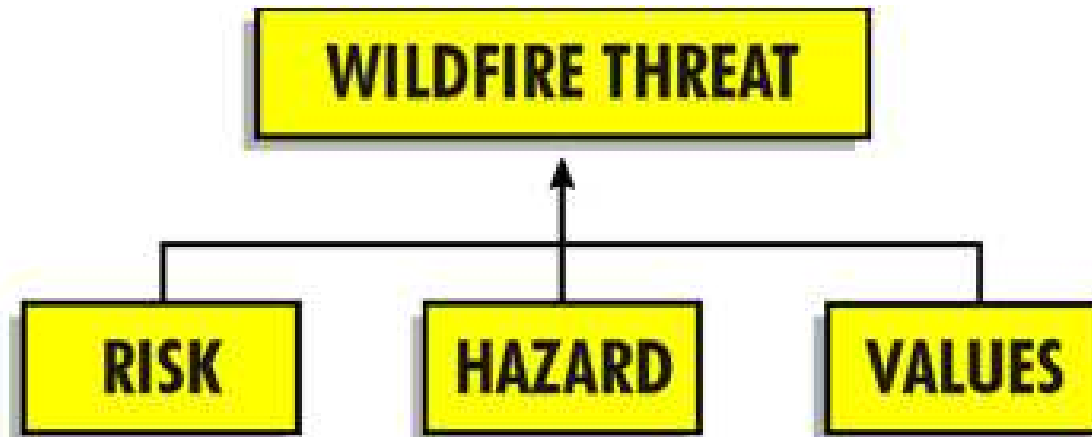
Wildfire Threat Analysis (WTA) framework developed in Canada and applied successfully at national and regional scale in New Zealand

Aim: to evaluate WTA at local scale for a forest-urban interface in SE England

Questions

1. How well does WTA fit with existing UK risk assessment frameworks?
2. Can WTA can be translated into practice as a pilot GIS tool for FCE, considering data availability and sources of uncertainty?

In WTA, threat is a combination of 3 separate GIS modules



Risk (probability) of a fire of a fire starting, regardless of size;
Risk of ignition (RoI)

Hazard of a fire spreading

The assets which would be affected; Values at risk (VaR)

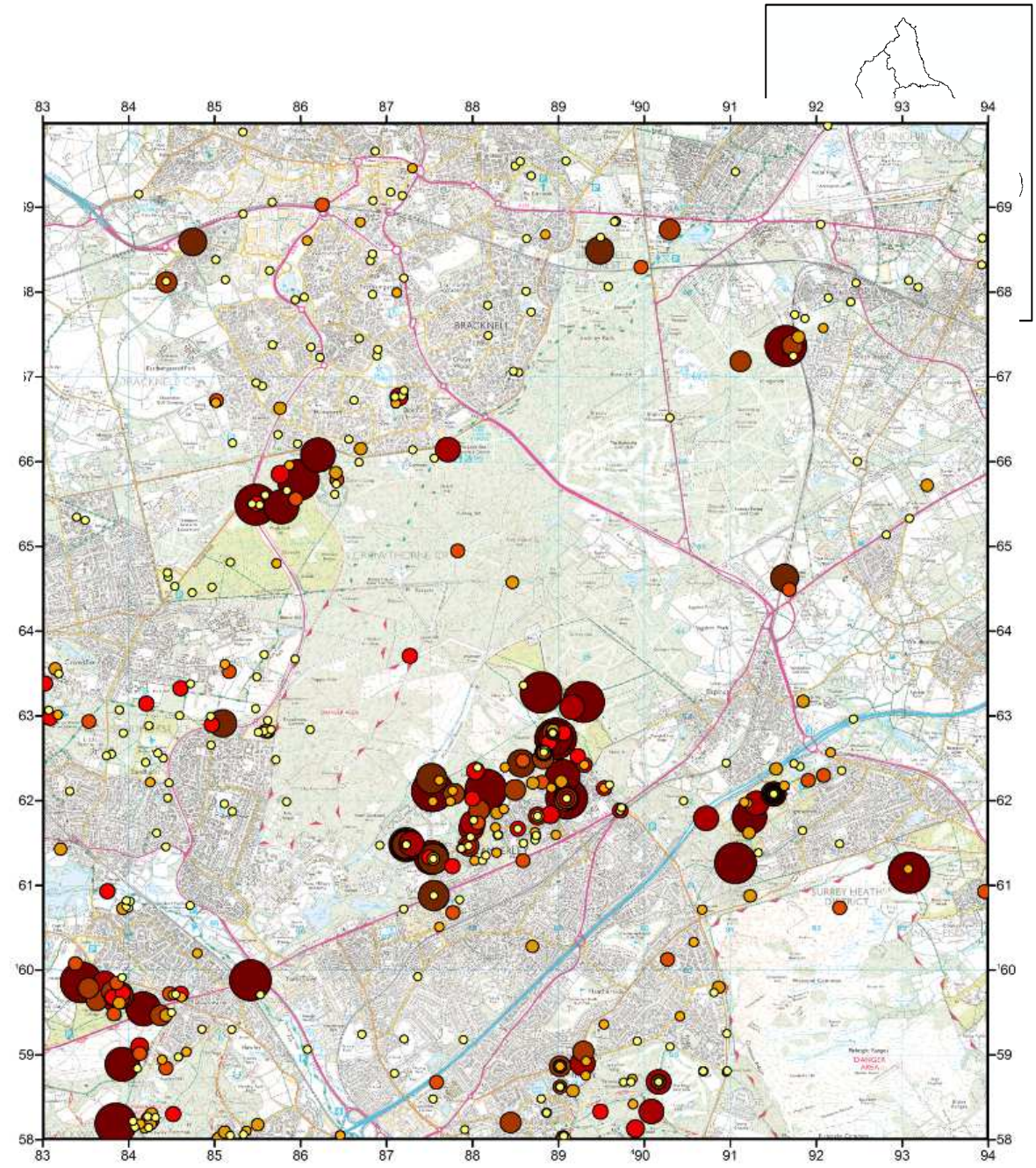
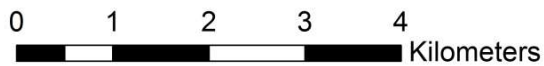
http://www.nrfa.org.nz/Operational%20documents/WTA_Wookbook.pdf

Case study area

964 attended fires in 4 yrs, 2009-2013; Fire Services' Incident Recording System (IRS)

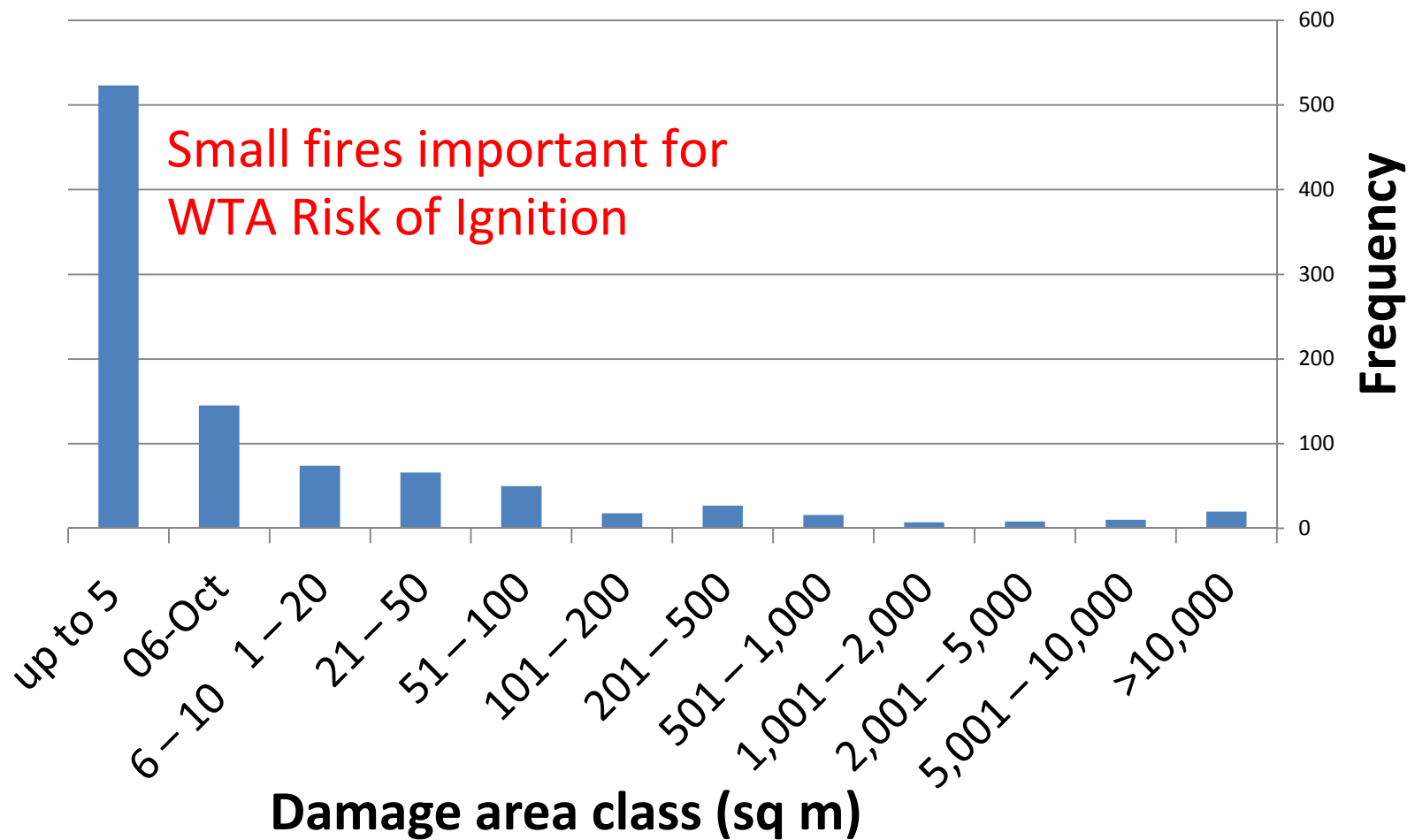


IRS data used to develop GIS layers



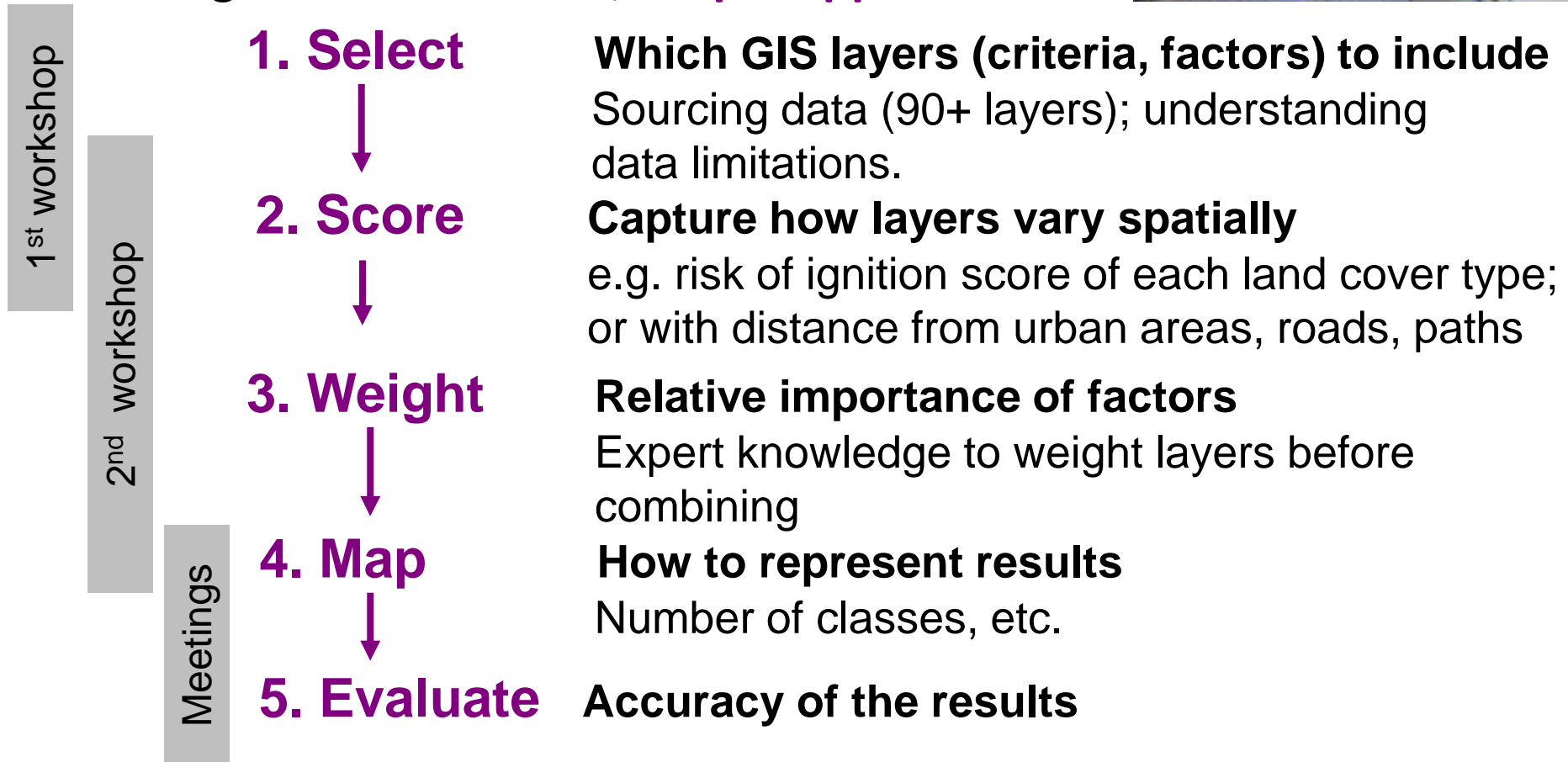
Base map is Ordnance Survey data © Crown Copyright 2014 © Edina Digimap

Fire size: IRS damage area, 2009/10 -2012/13



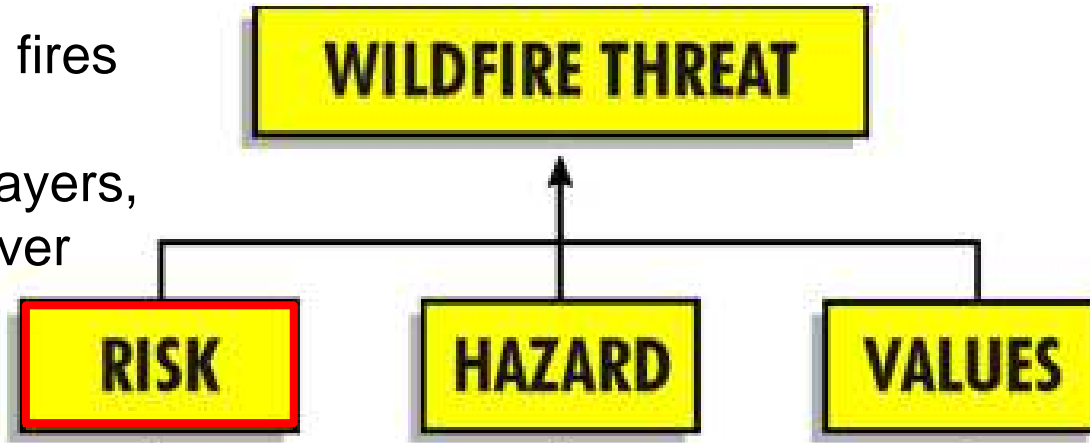
WTA Methods

For each module, **Multi-Criteria Evaluation** was used to combine GIS layers (criteria). Guided by expert knowledge from 2 workshops and meetings with individuals; **Delphi approach**

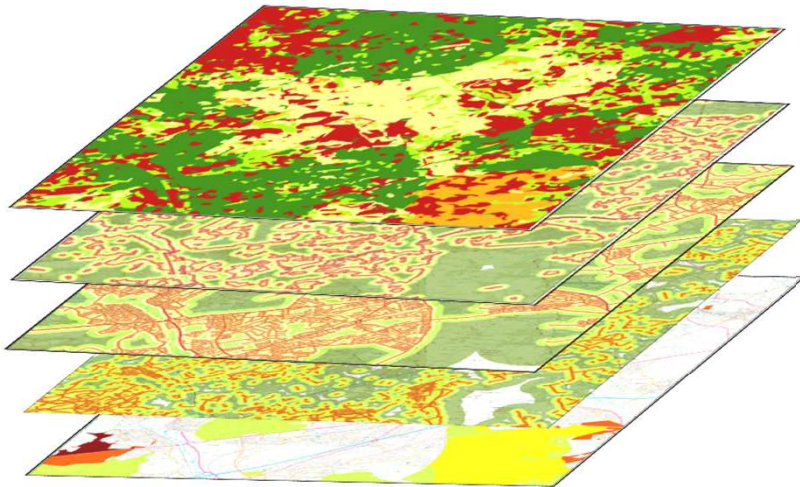


Each WTA GIS module is made up of map layers

IRS vegetation fires to score risk of ignition for all layers, except land cover



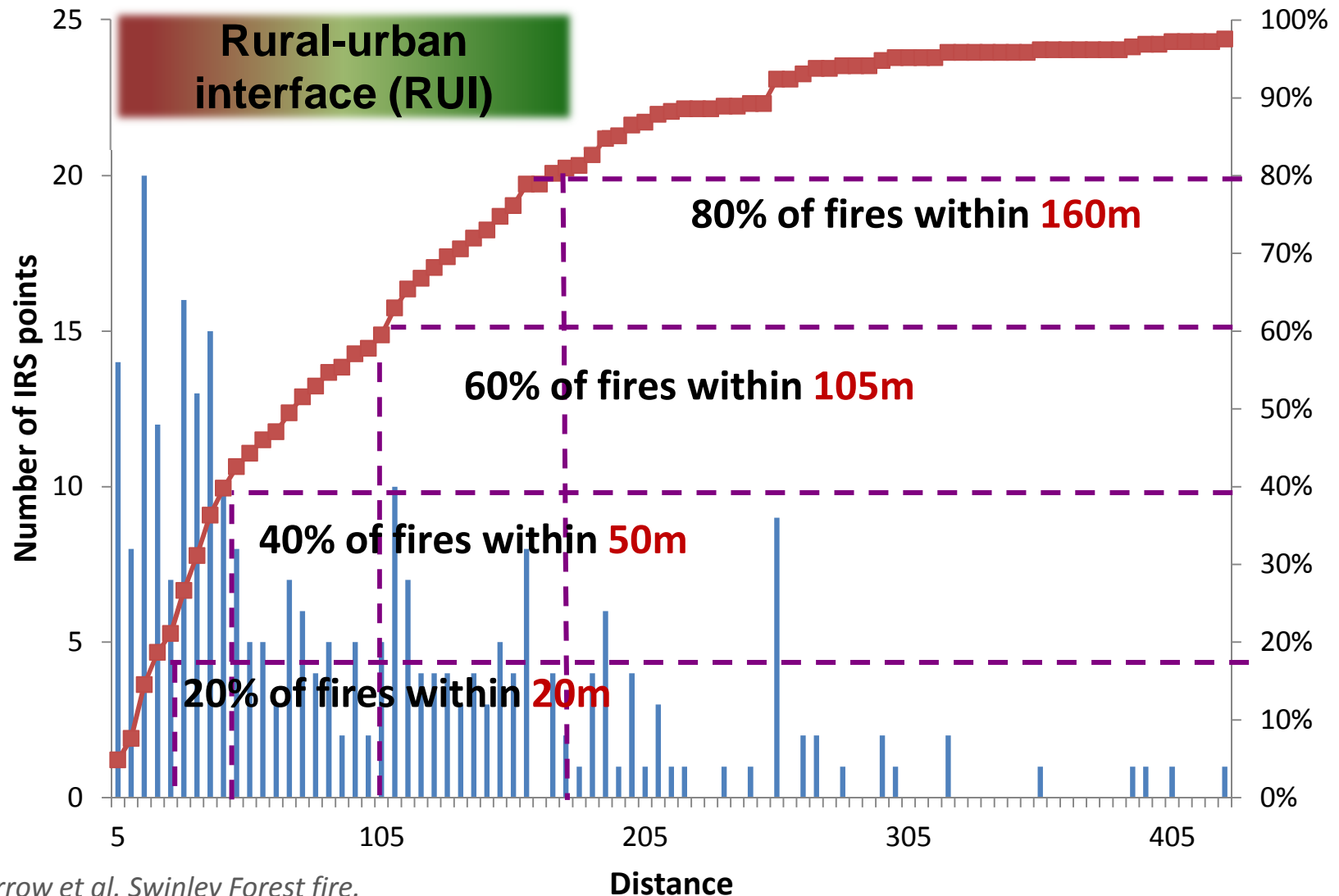
Probability of *sustained* ignition



- Land cover map 2007 + National Forest Inventory (proxy for fuel and intensity of use)
- Distance to urban areas
- Distance to roads
- Distance to paths
- Access Land
- *[Fine Fuel Moisture Code]*

Distance from urban boundary: 5 zones

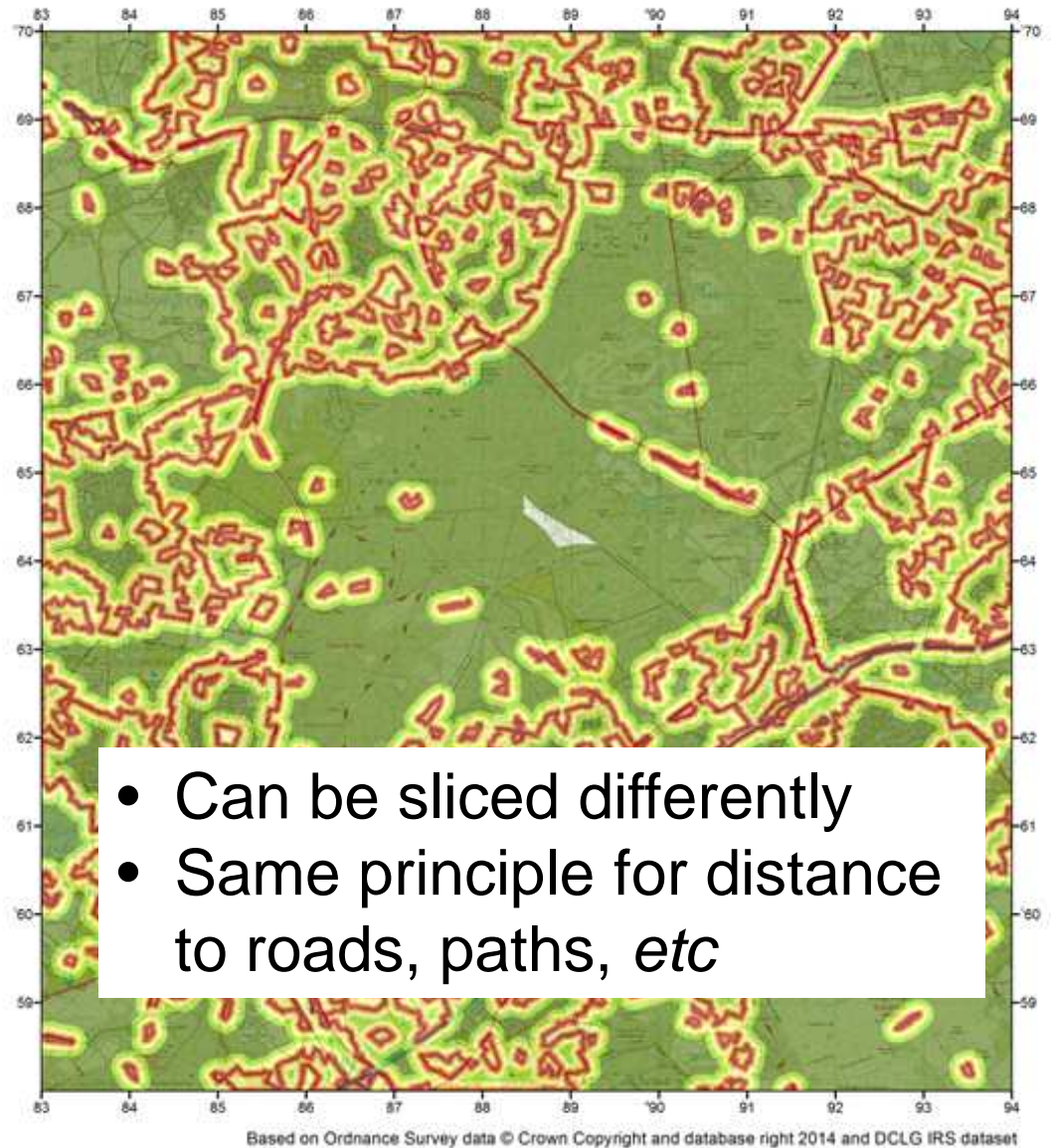
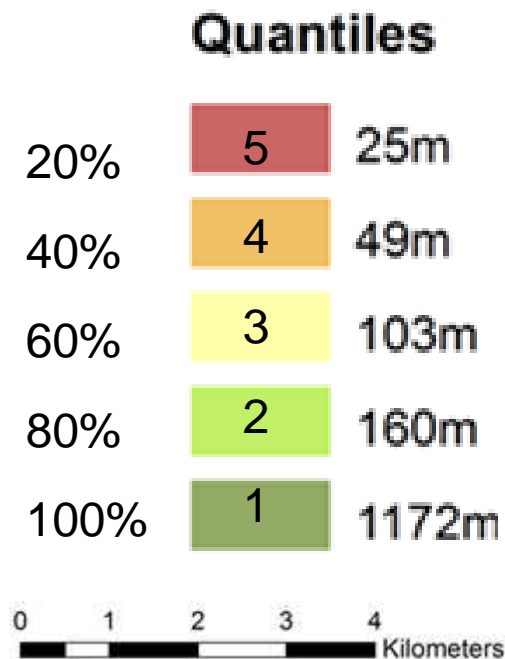
Caveat: accuracy depends on accuracy of IRS point locations



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Greenwich, 10 Apr 2015

Map layer for distance from built-up areas

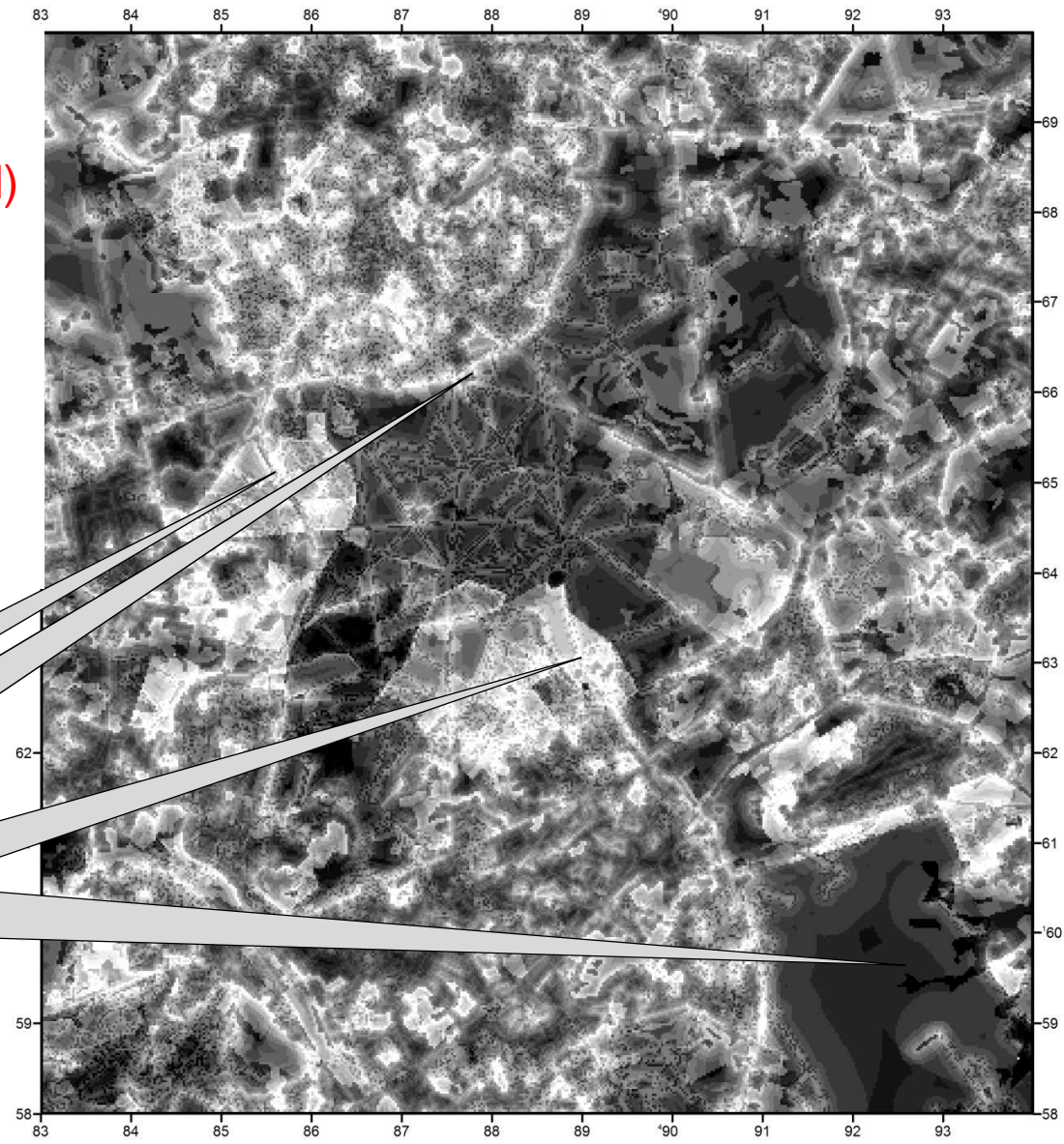
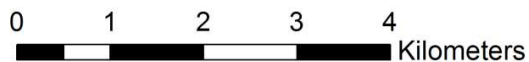
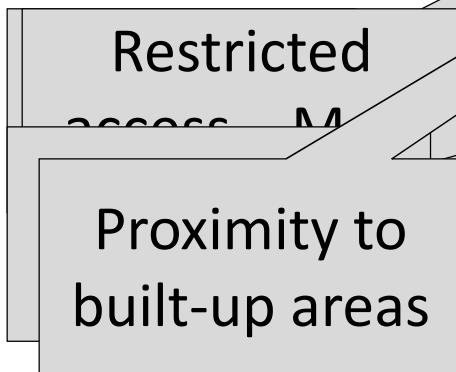
- Divide the map into zones at 25m, 39m, etc. from urban boundary
- Give higher score to zones closest to urban areas



Outputs: Risk of Ignition map to target prevention

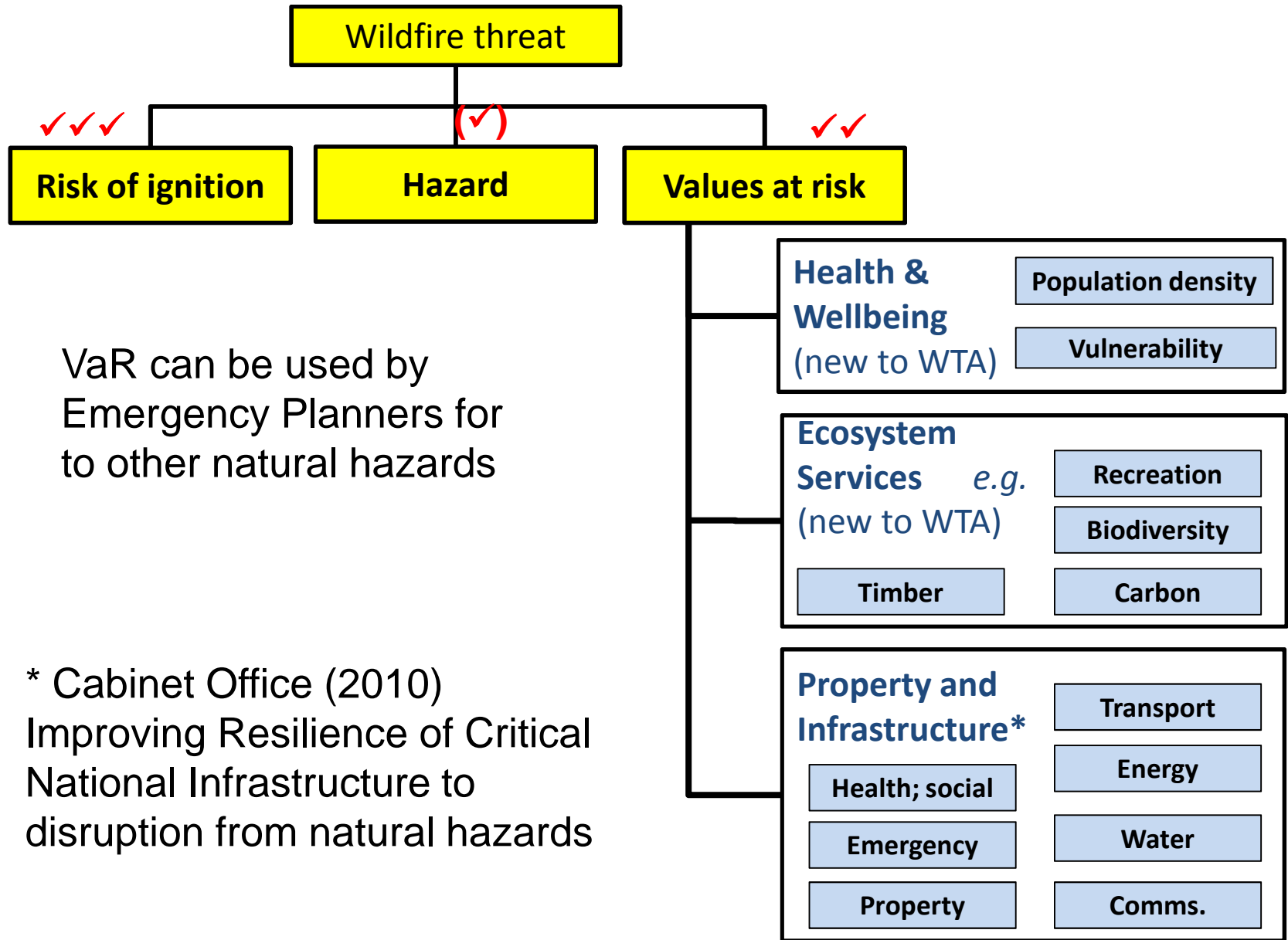
Weighted combination of:

- 4 Land cover: expert judgement (**IRS can be used**)
- 3.5 Proximity to built-up areas
- 3 Proximity to foot access routes
- 4 Proximity to car access routes
- 3 Access Land



Ordnance Survey data © Crown Copyright and database right 2014

Modified Wildfire Threat Framework



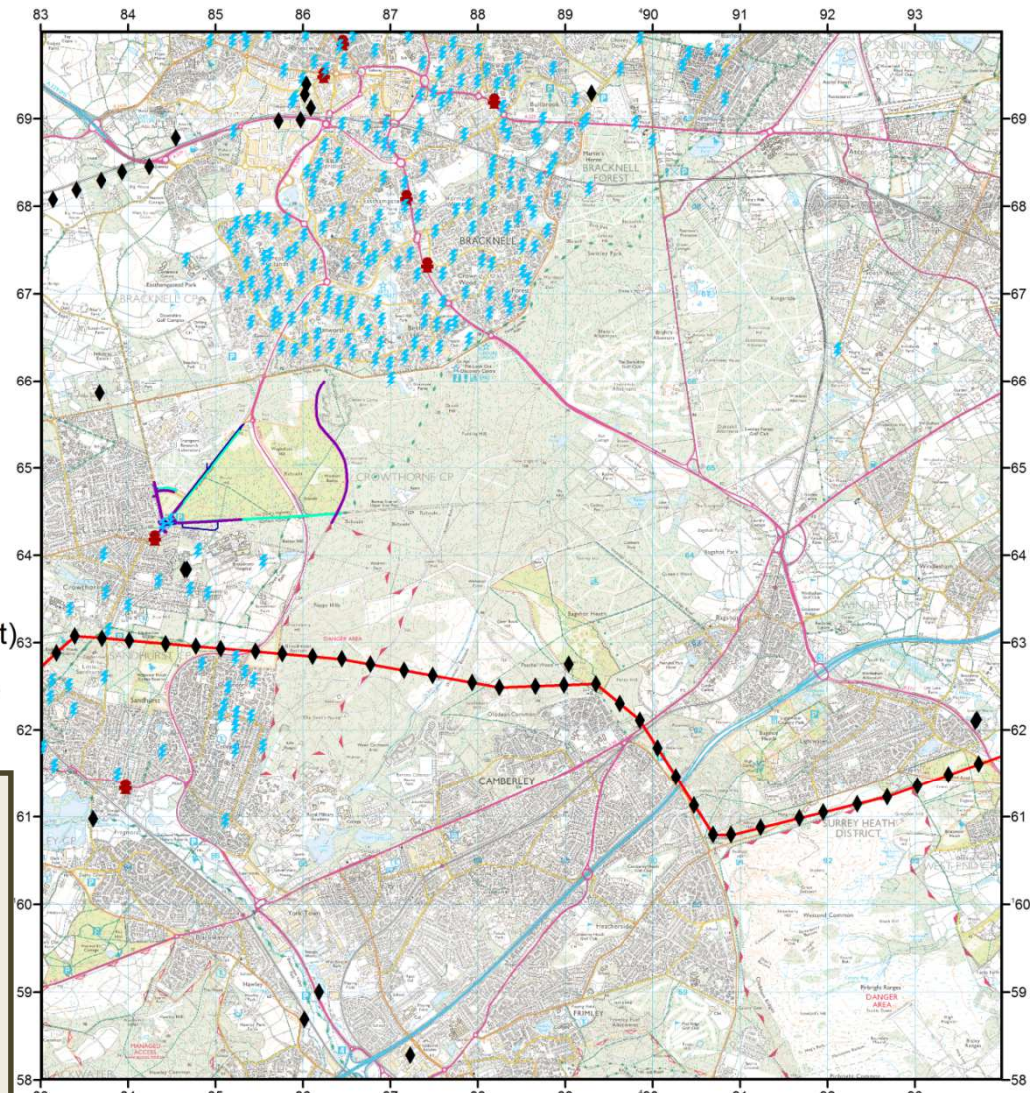
Example of Energy Values at Risk

Values at Risk

Property and Infrastructure: Utilities - Energy

- Electricity line (National Grid)
- Overhead powerline (Crowthorne)
- Underground powerline (Crowthorne)
- Gas Pipeline (Crowthorne)
- ◆ Electricity towers
- ⚡ Electricity Sub-stations (Bracknell Forest)
- ⛽ Petrol Filling Stations (Bracknell Forest)

Participants asked to assign value scores to different energy utilities categories, and suggest the width of buffer preventing damage.

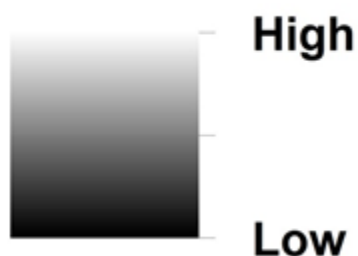


Sources: National Grid, Forestry Commission England
Ordnance Survey data © Crown Copyright and database right 2014

Values at Risk map to target forest management

Weighted combination of:

- 5 Health & well-being
- 3 Property & infrastructure
- 1 Ecosystems services

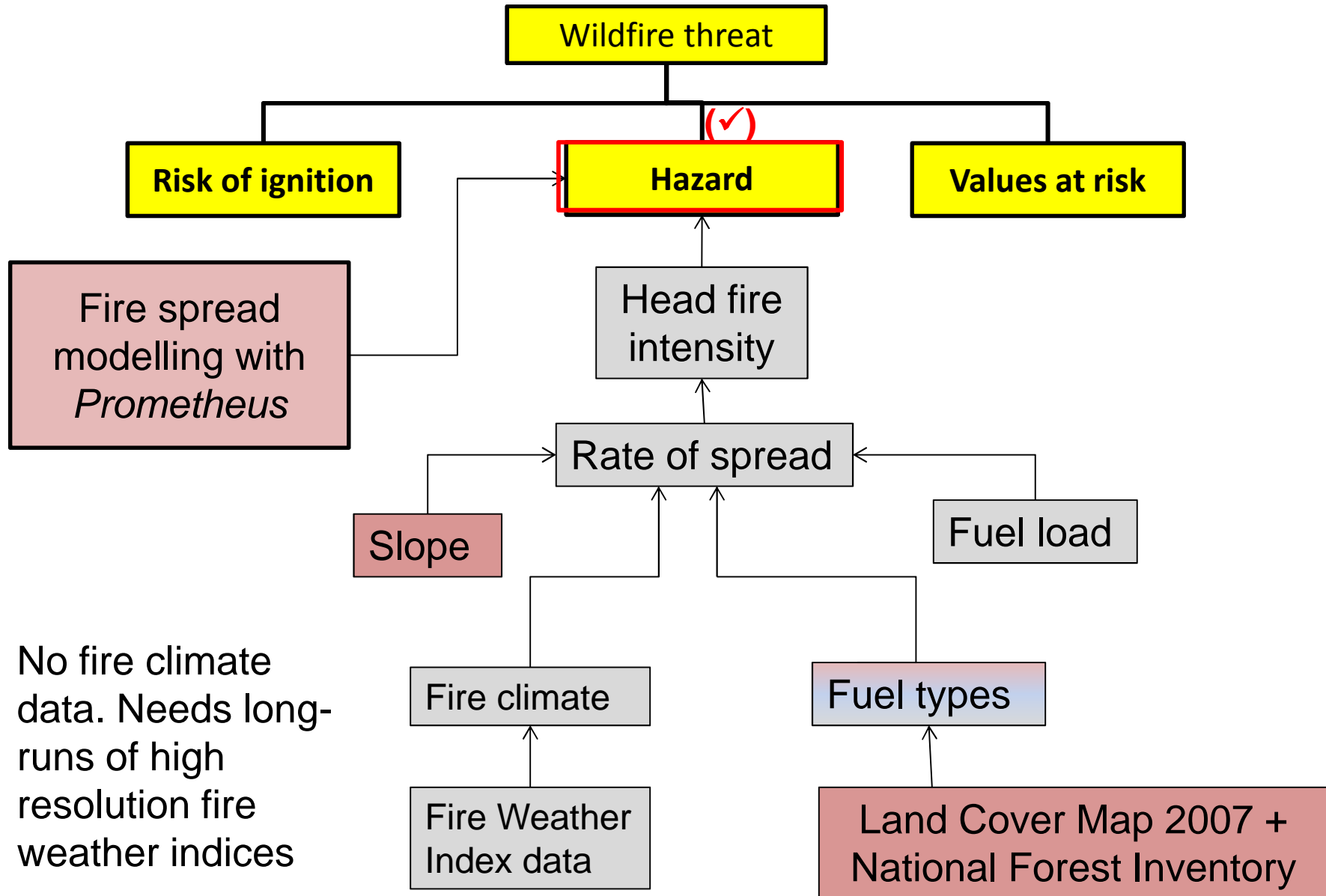


Overlay actual or simulated fire perimeter to quantify areas or number of values at risk..



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Modified Wildfire Threat Framework

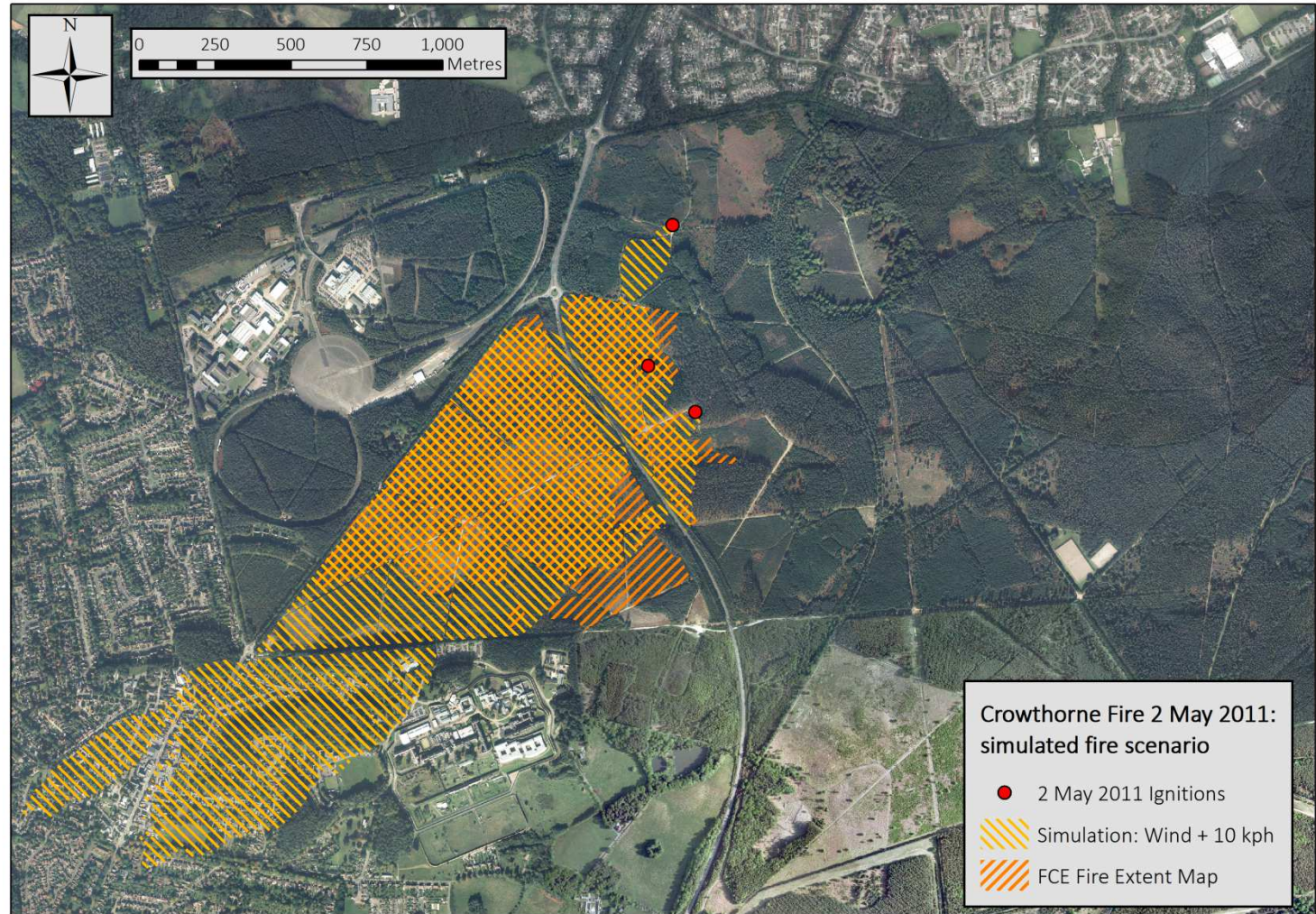


No fire climate data. Needs long-runs of high resolution fire weather indices

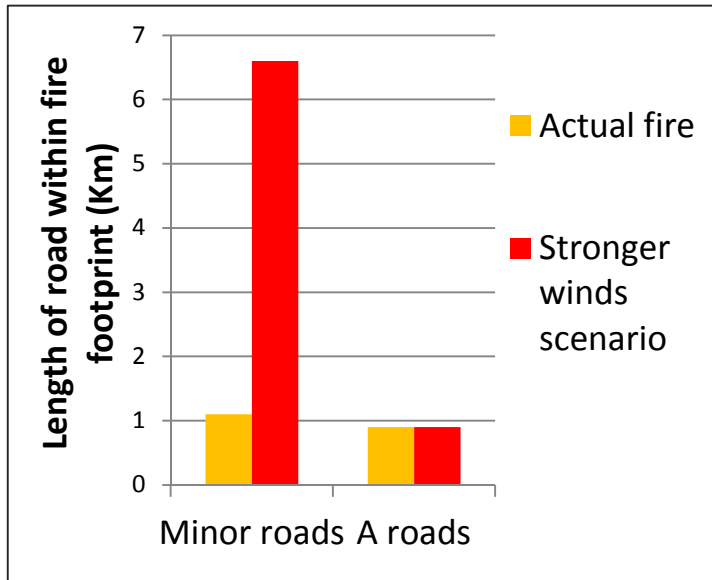
HAZARD: modelled fire footprints

Prometheus fire spread modelling scenarios; wind 10 kph stronger (courtesy of Tom Smith, KCL)

- 86% larger fire footprint
- Mostly conifer & urban
- Smoke plume not modelled

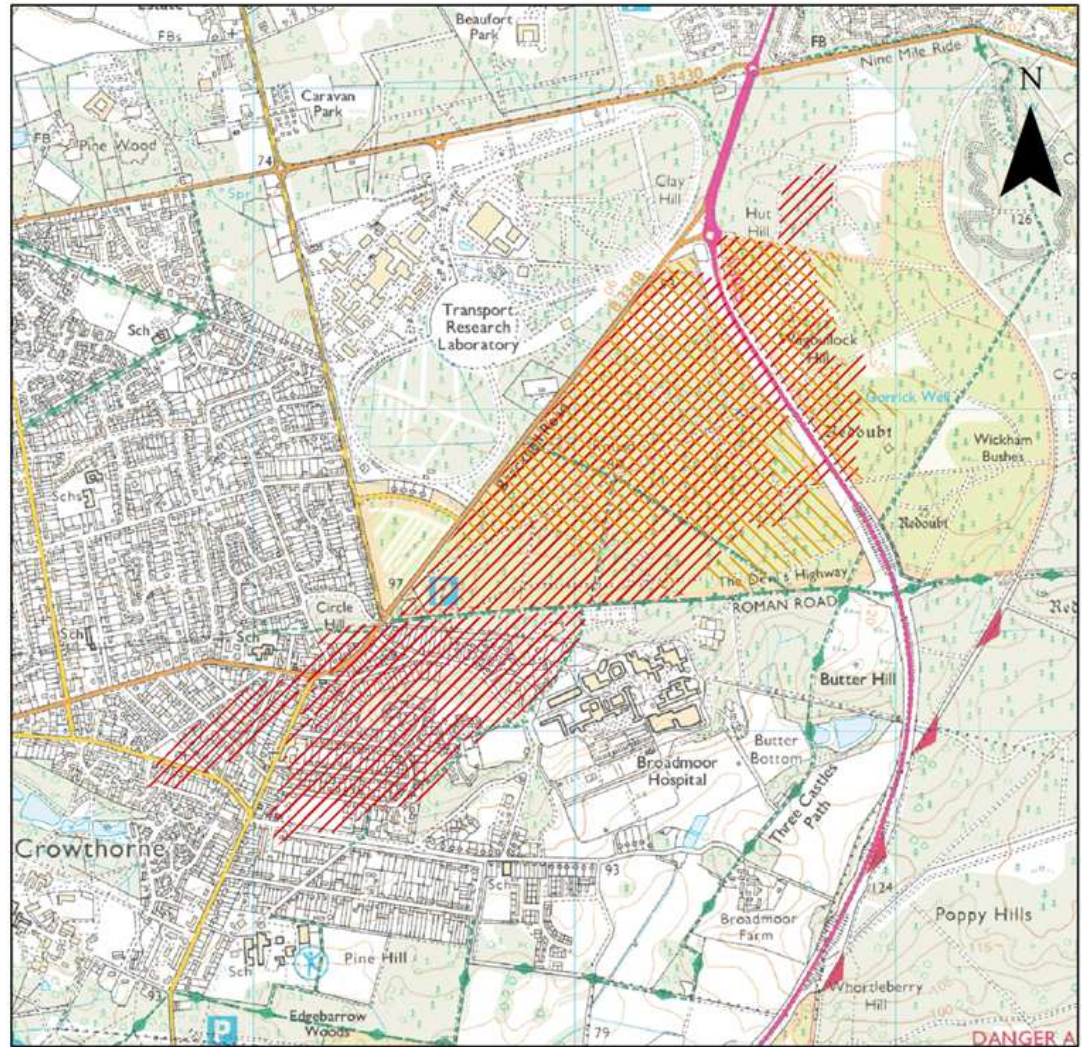


Overlay on VaR: avoided impacts. 'costs'



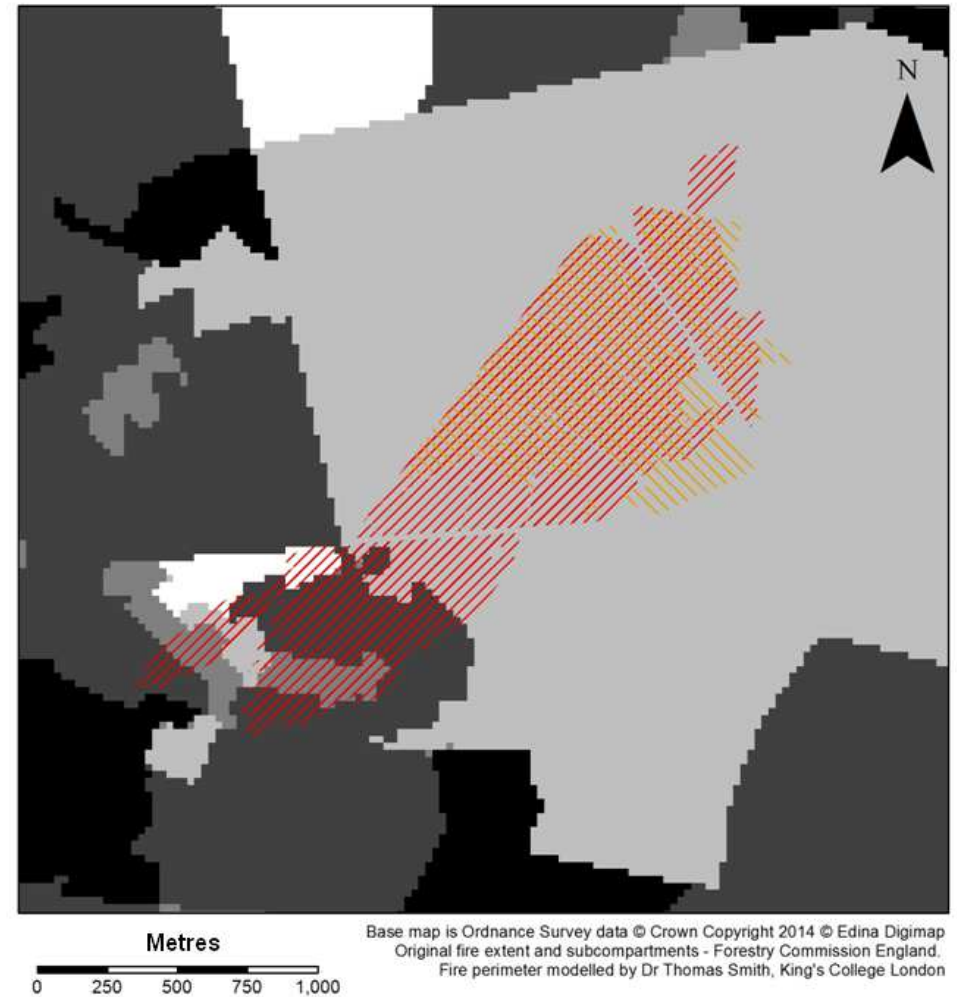
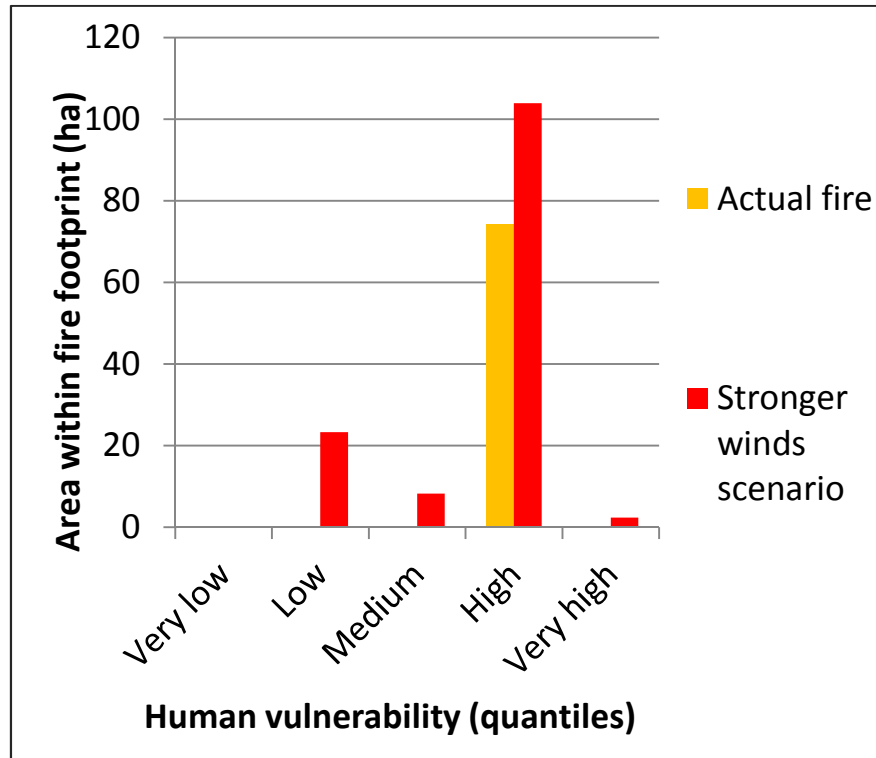
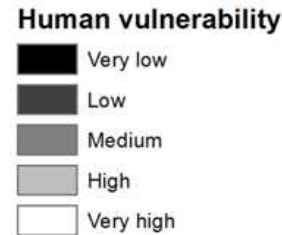
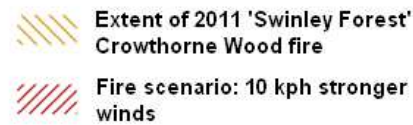
Within simulated fire footprint

- 13% greater area of timber (9 ha more)
- 6 x greater length of minor roads (5.5 km more)
- 33 ha urban; 791 properties, 1 listed building



Base map is Ordnance Survey © Crown Copyright 2014 © Edina Digimap.
Original fire extent is Forestry Commission England data.
Fire perimeter modelled by Dr Thomas Smith, King's College London

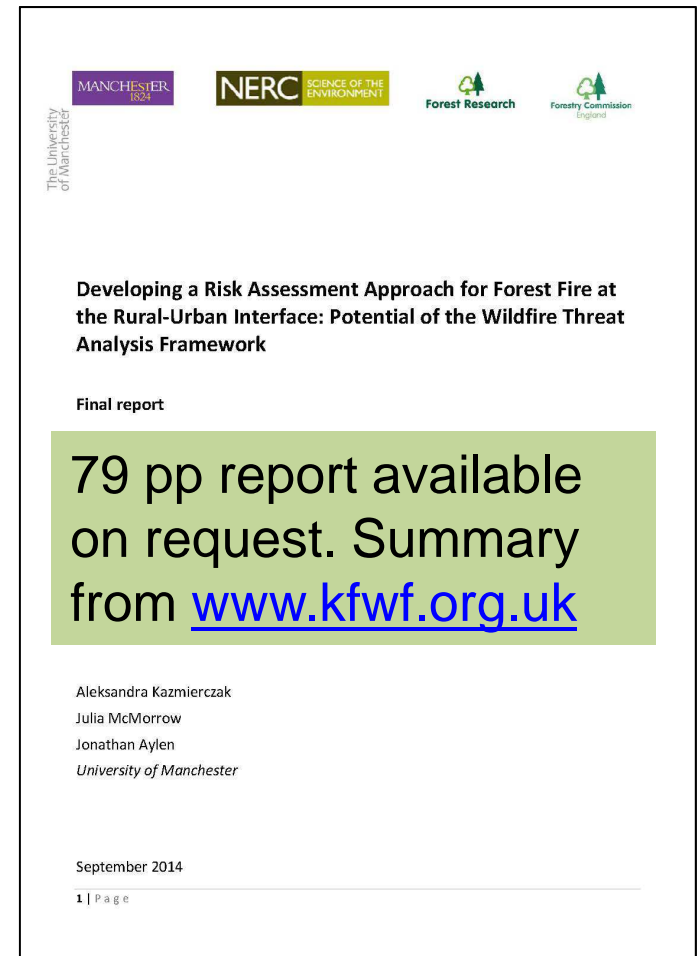
Human vulnerability



- 43% larger area in high or very high human vulnerability class

Successes

- **Buy-in** from 11 organisations (22 person-days) including FCE, Natural England, MoD, Emergency Planners, FRS
- **Data catalogue** of >90 layers, mostly publically available. Re-usable for other hazards
- **WTA adapted** for UK forest-urban interface: added **ecosystem services** and **social vulnerability** – NZ following suit
- **Identified RUI**, 80% fires within 160m
- Potential for **‘What if’ scenarios**:
 - update to post-2011 fire – how was threat changed by fire itself?
 - management, new housing/footpath/Country Park, etc?



*McMorrow et al. Swinley Forest fire.
Greenwich, 10 Apr 2015*

Issues and recommendations

- **Data collation effort** from multiple sources; mostly national datasets, but local data availability and quality varies. Update maps every 5 yrs. Re-use for/from other hazard assessments.
- **Add other ecosystem services** to VaR
- **Is IRS location accurate?** Need nationally-consistent, agreed point on fire ground, ideally estimated ignition point. Preferably fire perimeters
- **Test scalability & transferability** to landscape scale (25m → ≥100 m cells); to other types of RUI, especially moorland. **Most useful scale?**
- **Variable stakeholders' views** on weighting factors. Trying a more objective method; logistic regression based on IRS with 1 ha cells
- **Importance of local stakeholder knowledge for VaR:** *“The [VaR] maps are difficult to understand without having gone through the stages”* **Keep VaR locally defined?**
- **Develop landscape-scale Hazard module** using 2km Fire Weather Indices with fire ensemble spread modelling (KCL)

Nested WTA: national + landscape scales

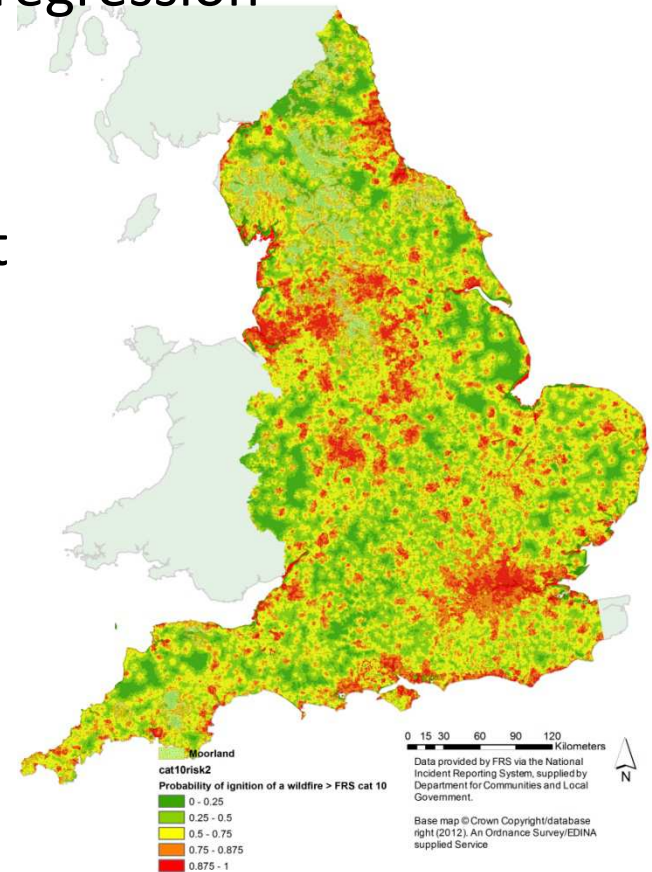
Combine Manchester and KCL projects in a nested approach: national (2km) and landscape-scale (≥ 1 ha):

1. National RoI module; IRS-based logistic regression

... incorporating KCL/Met Office's 2km probabilistic Fire Weather sub-indices, calibrated against Fuel Moisture Content
→ seasonal 'ignitability'

2. National 'worst case' wildfire hazard, using KCL/Met Office Fire Weather sub-Indices with slope, aspect, fuel/land cover

3. Combine national RoI with national Hazard → critical areas for landscape scale WTA, especially VaR



Further information

www.Kfwf.org.uk

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Thank you for listening

