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Working with water

Recent developments in loss of life and evacuation modelling for flood event management in the UK

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Flood incident management in the UK

Flood detection

Flood forecasting and interpretation

Flood warning dissemination

Flood warning and emergency response

The role of loss of life and evacuation modelling to support and improve flood incident management

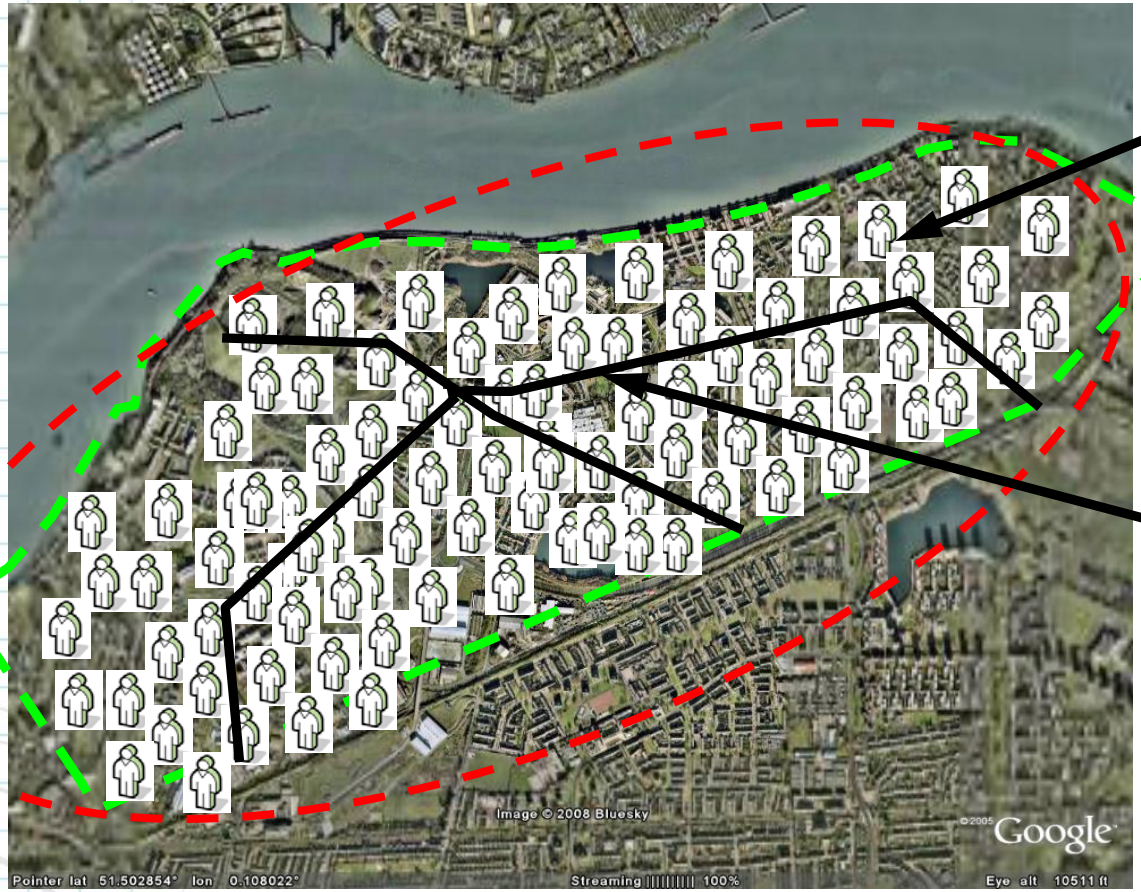
Issue with emergency planning for floods in UK

- Lack of communication to general public
- Identification of evacuation routes and safe havens
- Vulnerable groups (e.g. the elderly) and areas (e.g. caravan sites) are often not identified
- Limited risk assessments for dam breaches and flood defence failures in terms of loss of life and evacuation

Supporting incident management
Loss of life and evacuation modelling

- Time to evacuate
- Loss of life, and how its affected by:
  - Road closures
  - Warning dissemination
  - Use of safe havens
  - Awareness
- Quantified reporting, number of:
  - Fatalities and injuries
  - Vehicles swept away
  - Buildings destroyed

Levels of modelling - Macro

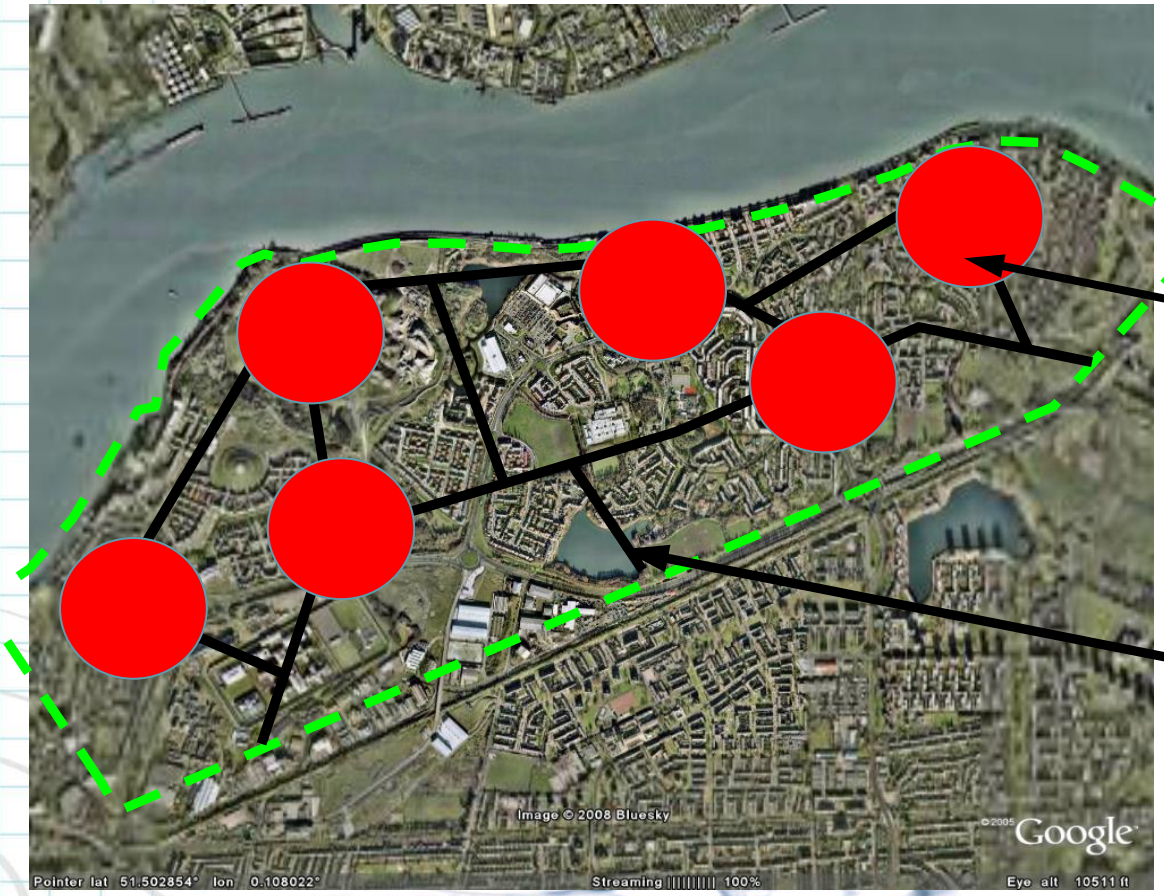


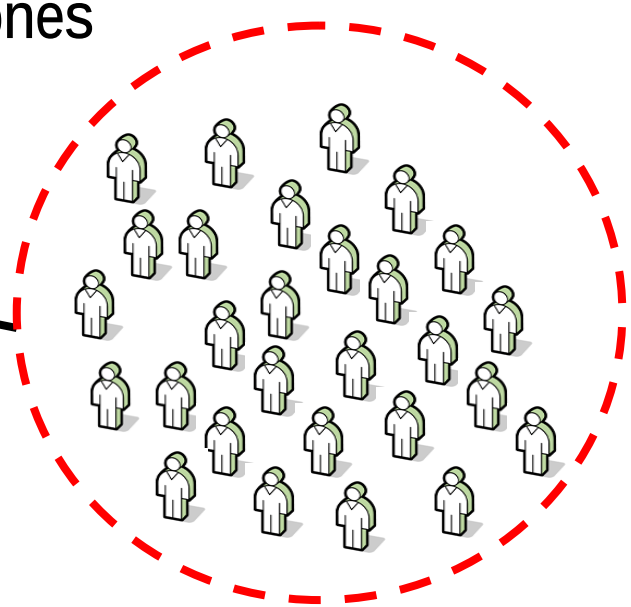
One mortality rate applied to the whole area

Evacuation time based on average distance to safety

Levels of modelling - Meso

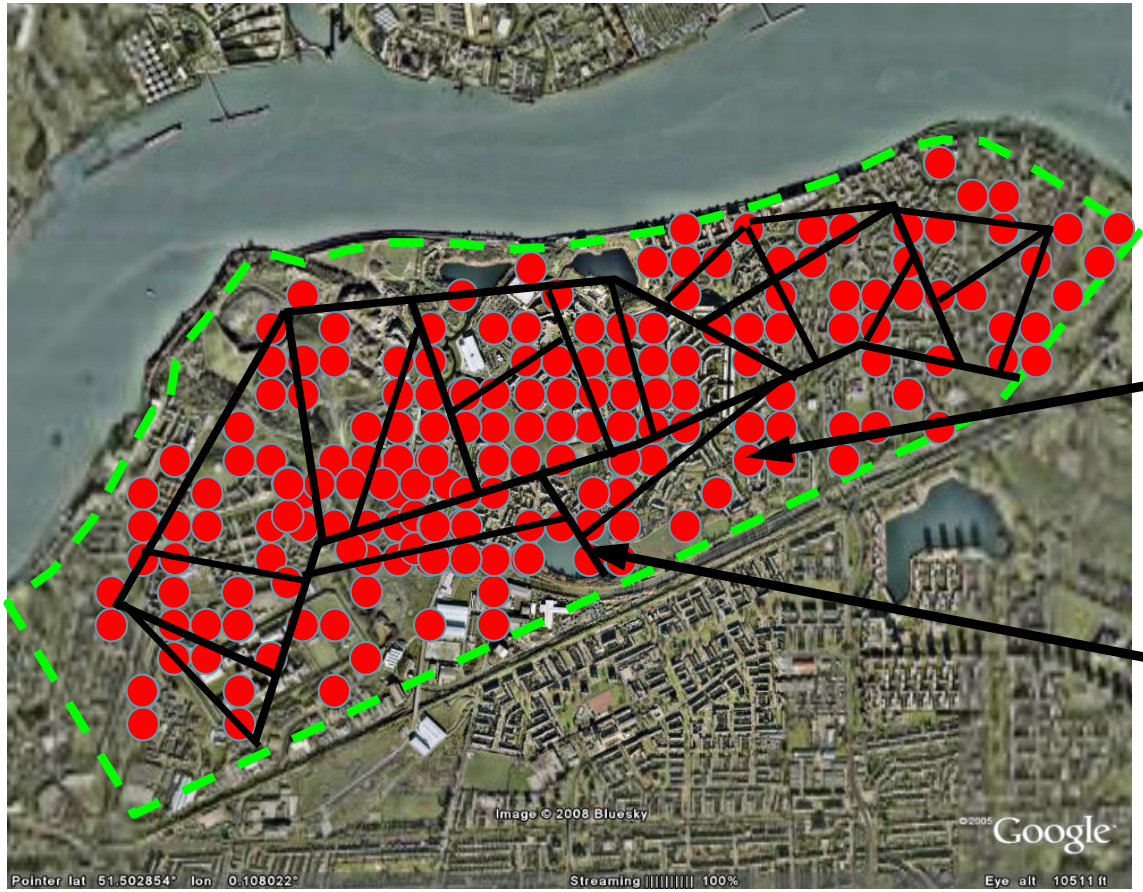
Mortality rates estimated for groups of people or zones



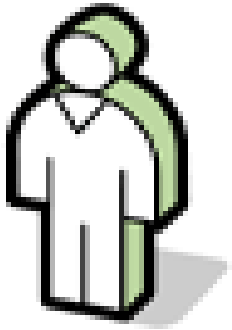


Simplified evacuation routes

Levels of modelling - Micro



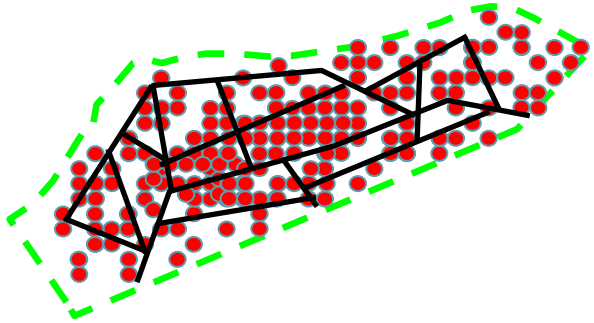
Behaviour of each individual is modelled



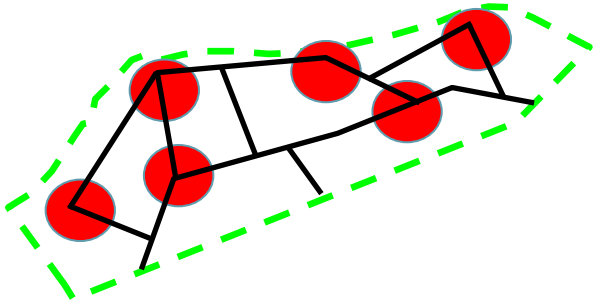
Detailed representation of evacuation routes

Typical scale of application?

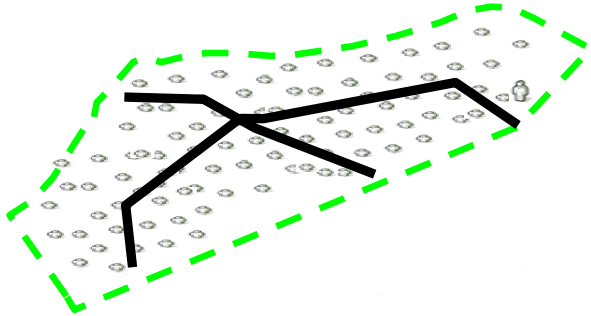
Micro



Meso



Macro



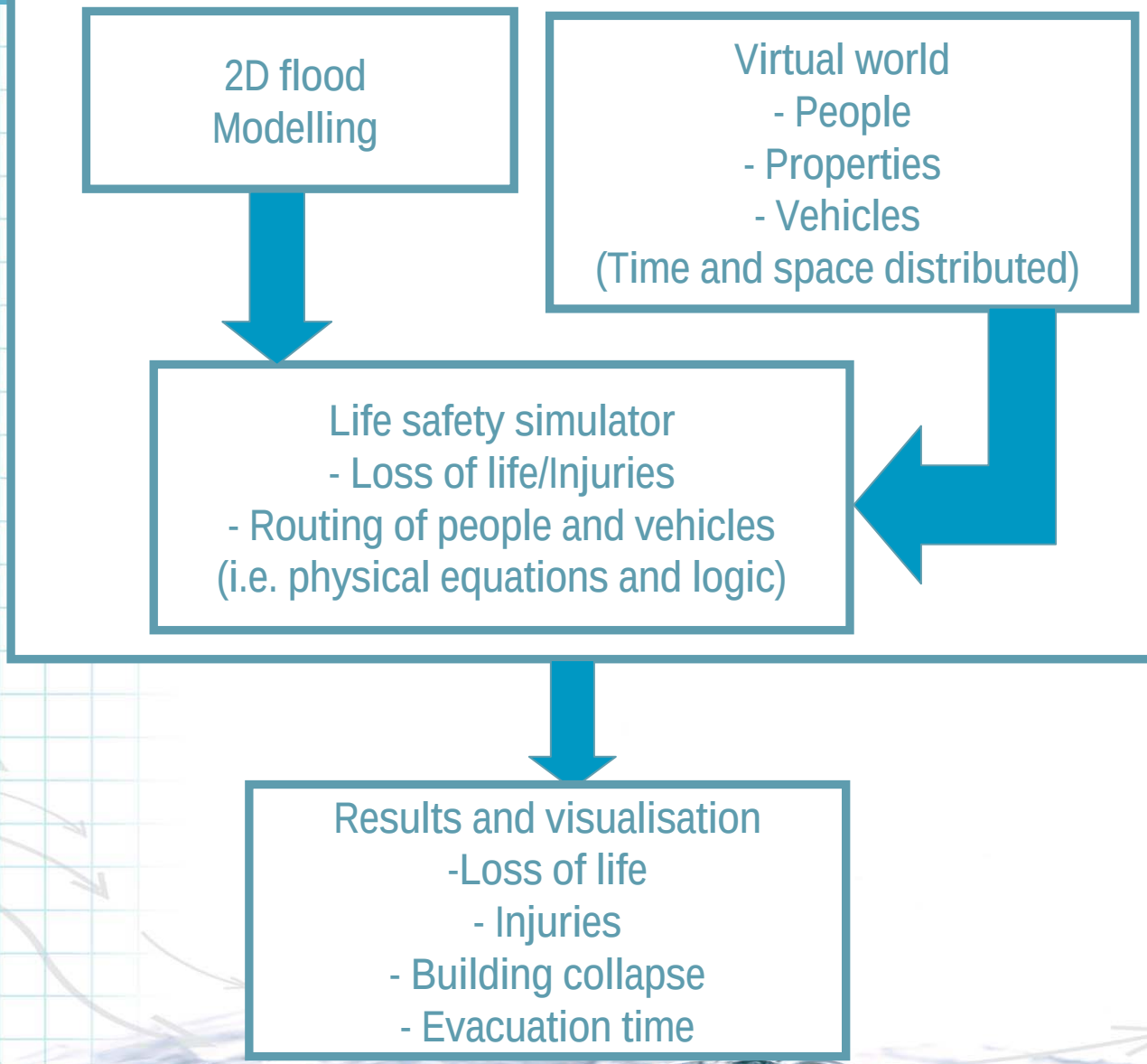
Small area/
Detailed study/
High risk

Regional/
Broad scale study/
Lower risk

Micro scale - BC Hydro Life Safety Model (LSM)

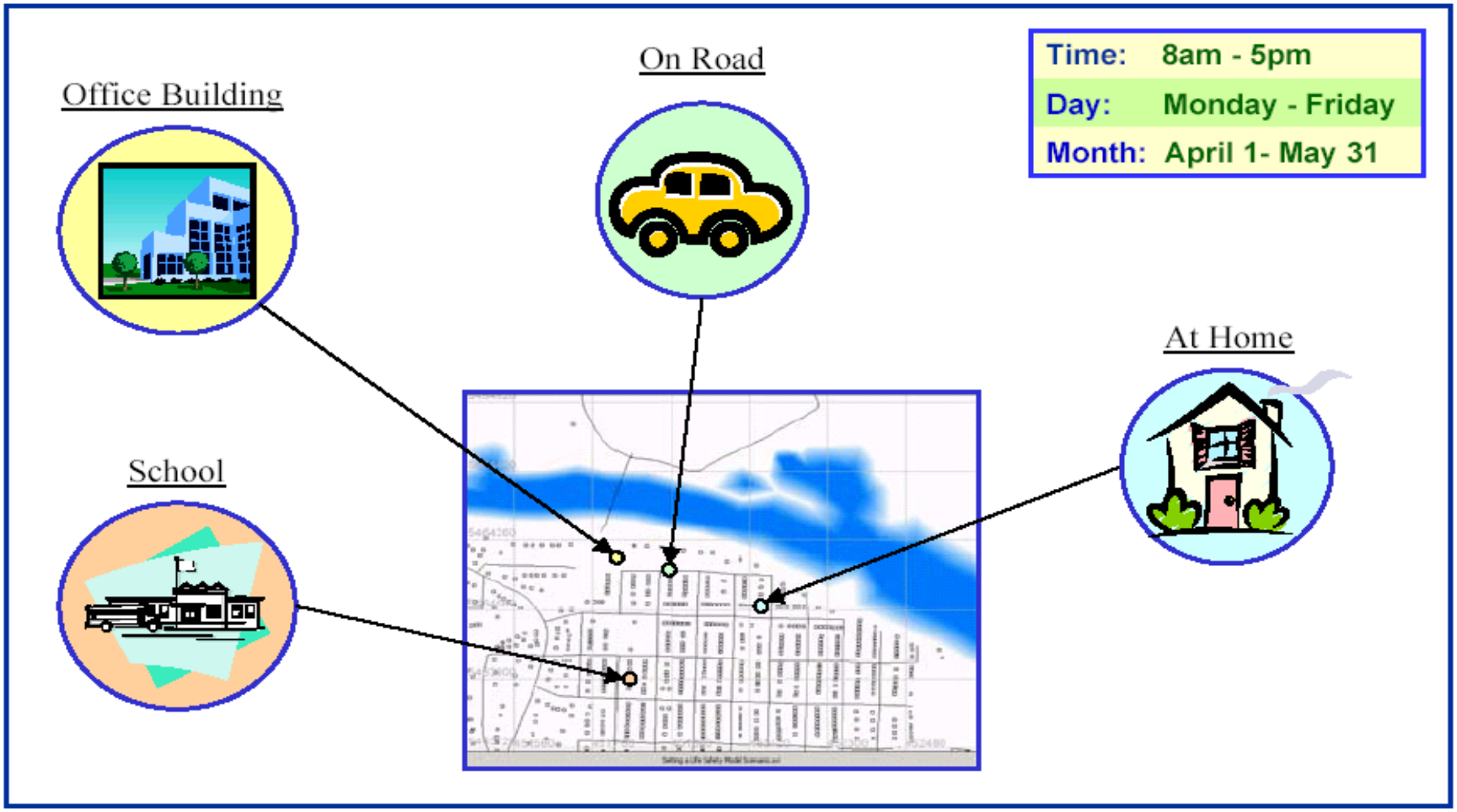
- Allows dynamic interaction between receptors (i.e. people, vehicles and buildings) and the flood wave
- Estimates loss of life from:
  - Drowning
  - Exhaustion
  - Building collapse
  - Cars being swept away
- Allows the effects of interventions (e.g. road closures, number and location of safe havens) on the evacuation time and risk to people to be assessed

Life Safety and Evacuation Model



Overview of the LSM modelling process

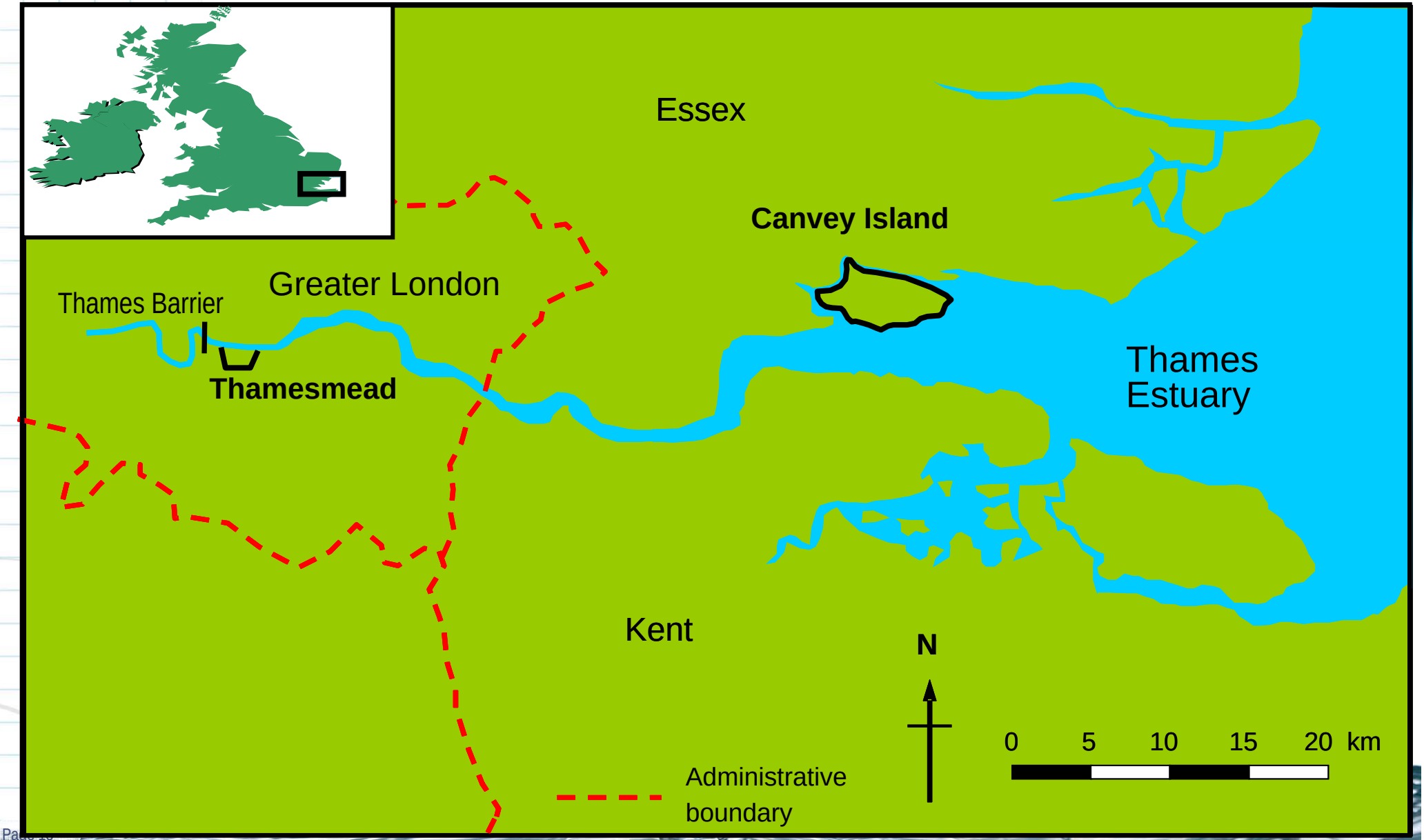
BC Hydro LSM – Creation of a virtual world



Readily available data in the UK

- Population data from census
- Number of vehicles from census
- Topographic data
- Flood depths and velocities from two dimensional hydraulic model
- Property data from a geo-reference National Property Data set
- Road network data
- Historical data (e.g. 1953 flood)

Thames Estuary - Pilot sites



Thamesmead - Background

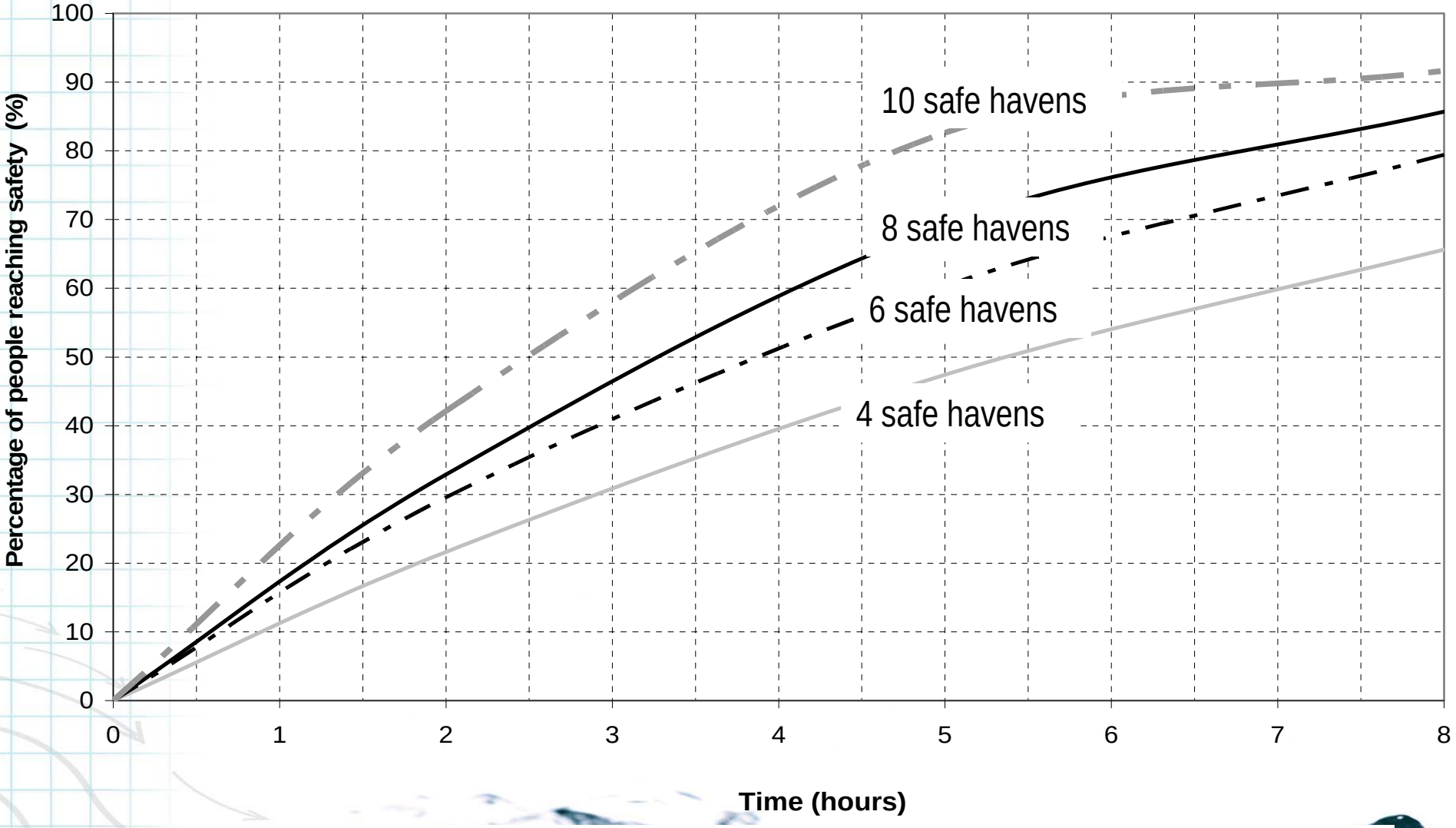

BARKING
A125
DAGENHAM
EAST
HA
Abbey
Belv
Abbey
Wood
A206
Plumstead
arlton
5

Thamesmead – Modelled scenarios

- A range of important inundation scenarios modelled
- Varied number of safe havens
- Varied number of road closures
- Difference in warning rates and number of warning centres

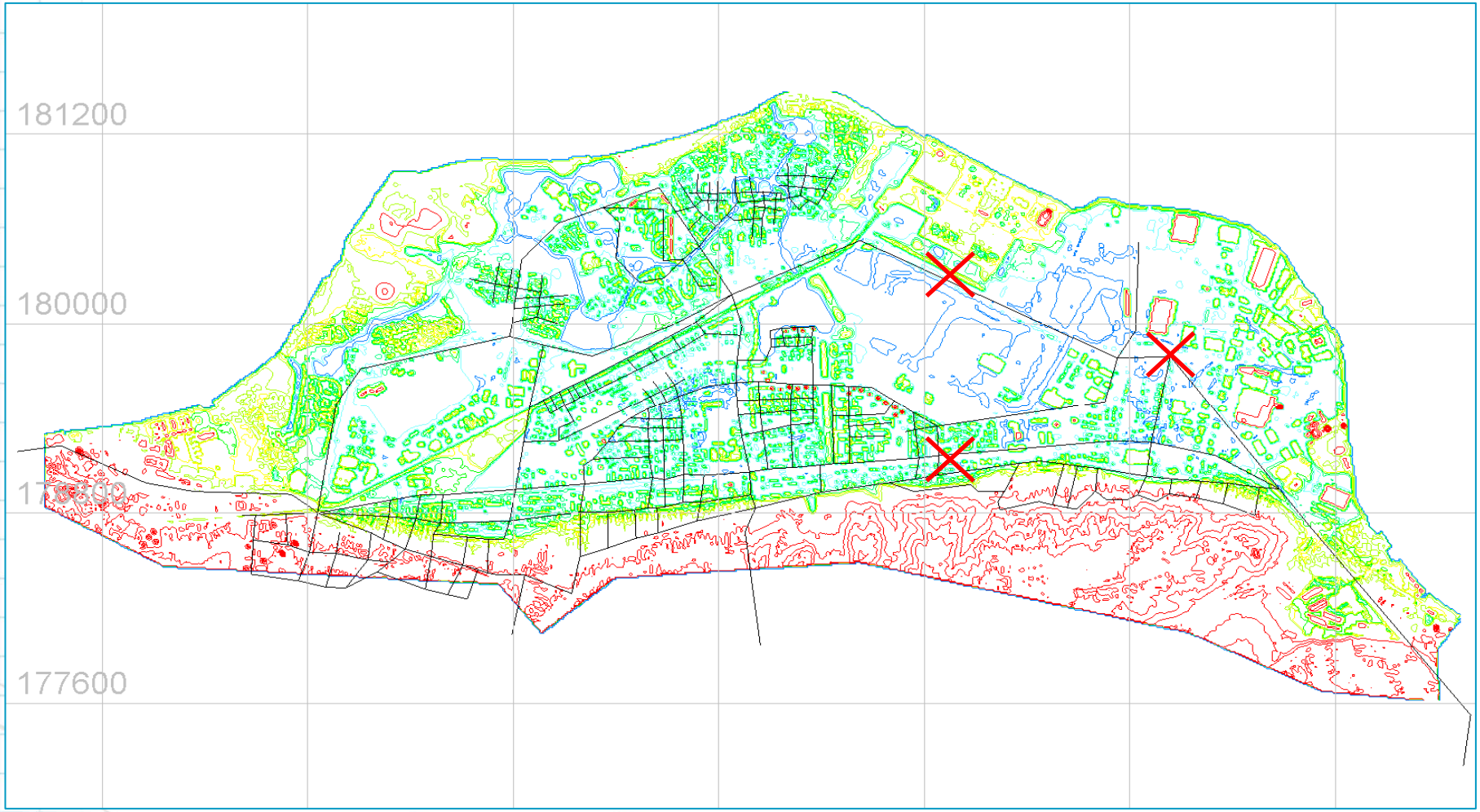
Thamesmead – Modelled scenarios

Evaluation of different scenarios - Safe havens

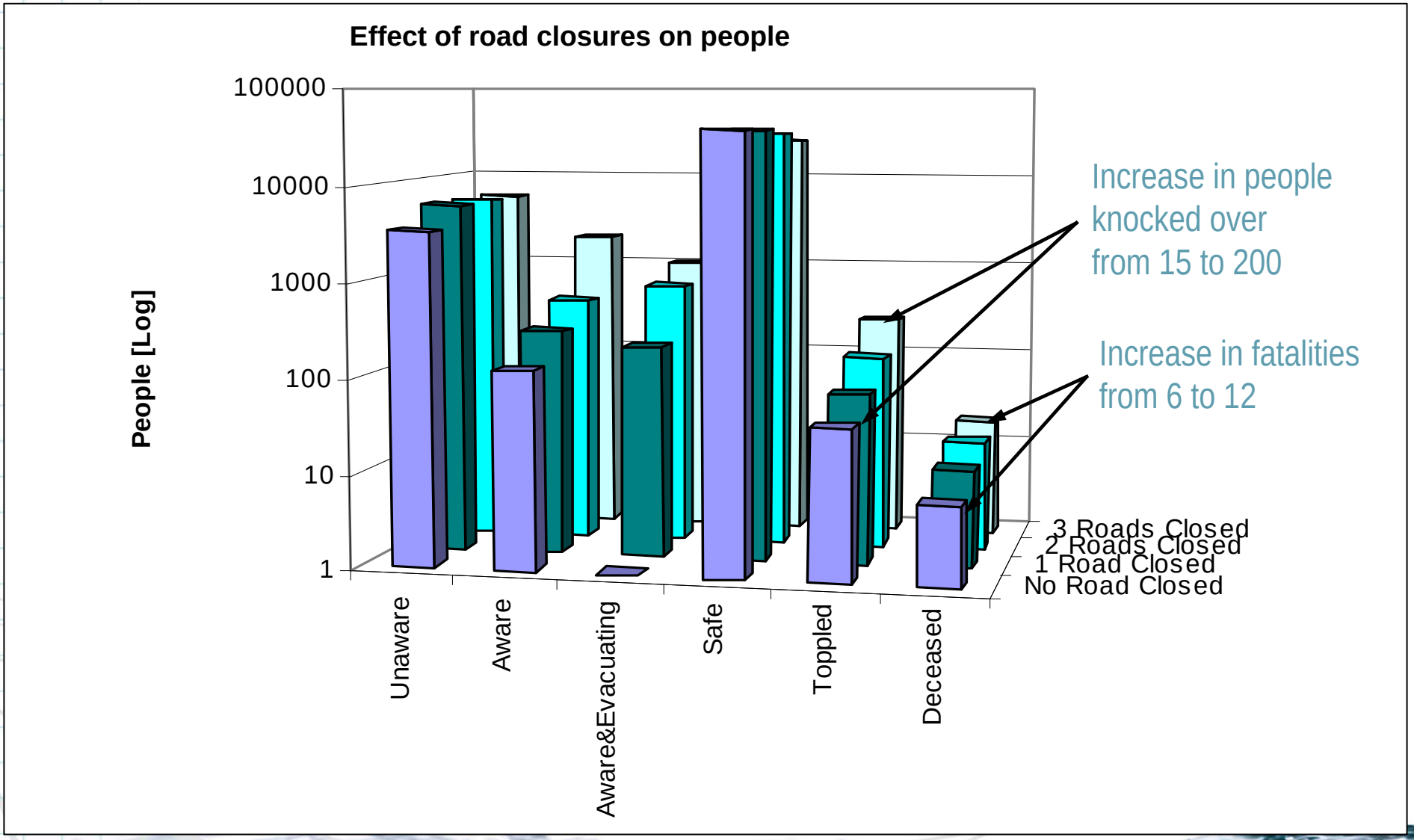


Percentage of people that reach a safe haven analysed for different time steps and for different numbers and locations of safe havens

Effect of road closures



Effect of road closures on evacuation and loss of life



Canvey Island

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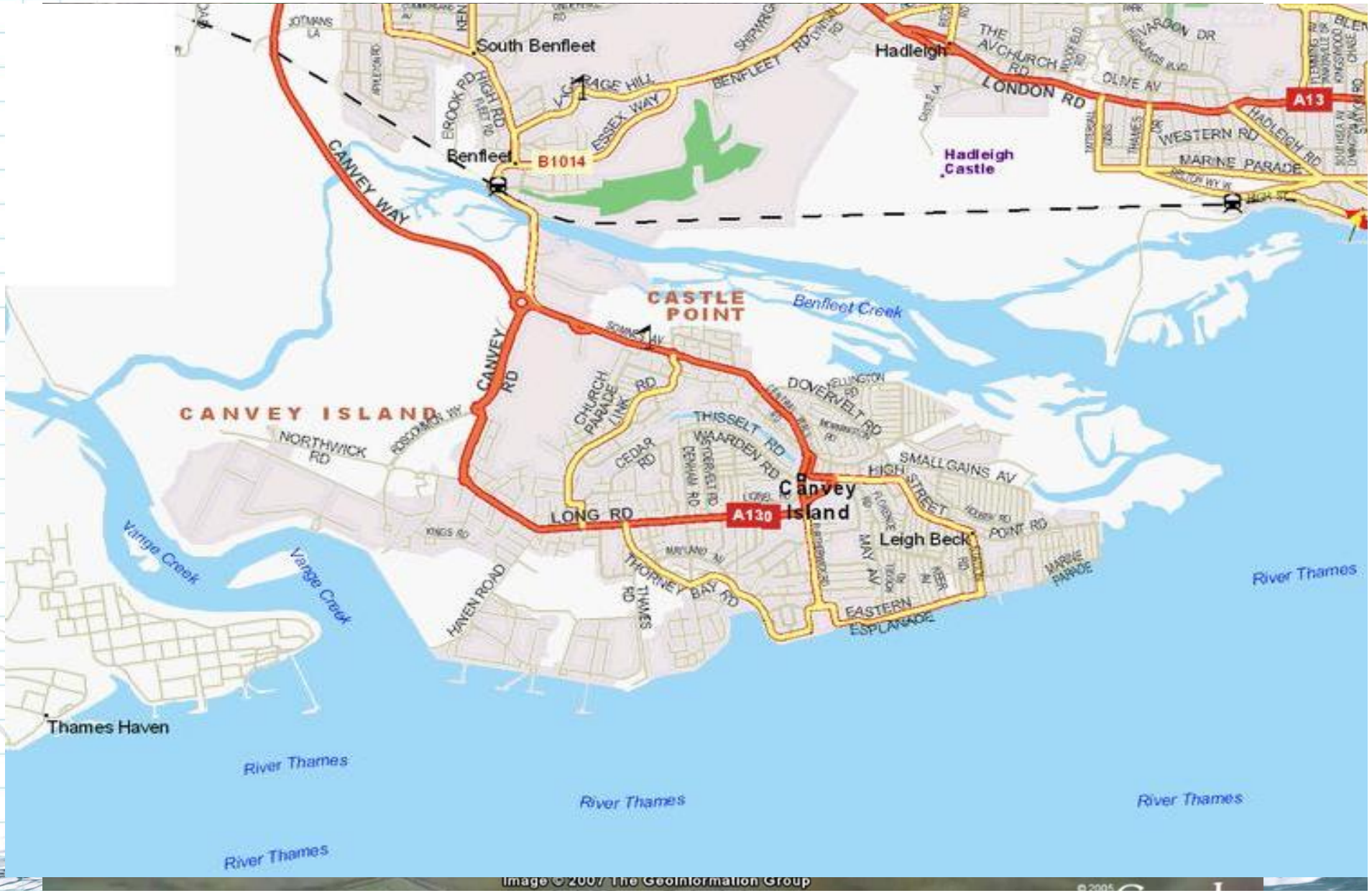
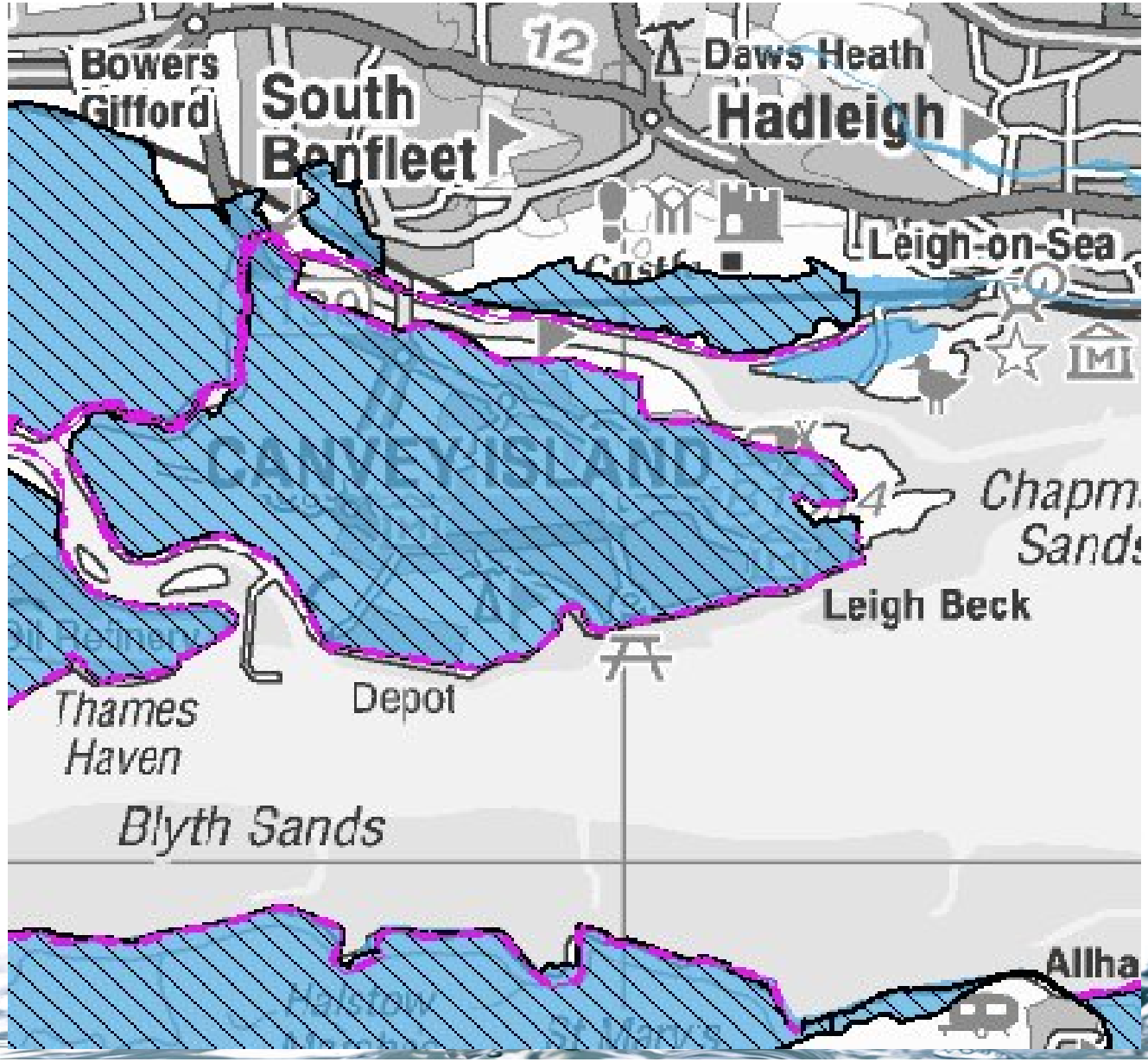
Canvey Island



Canvey Island – Flood map



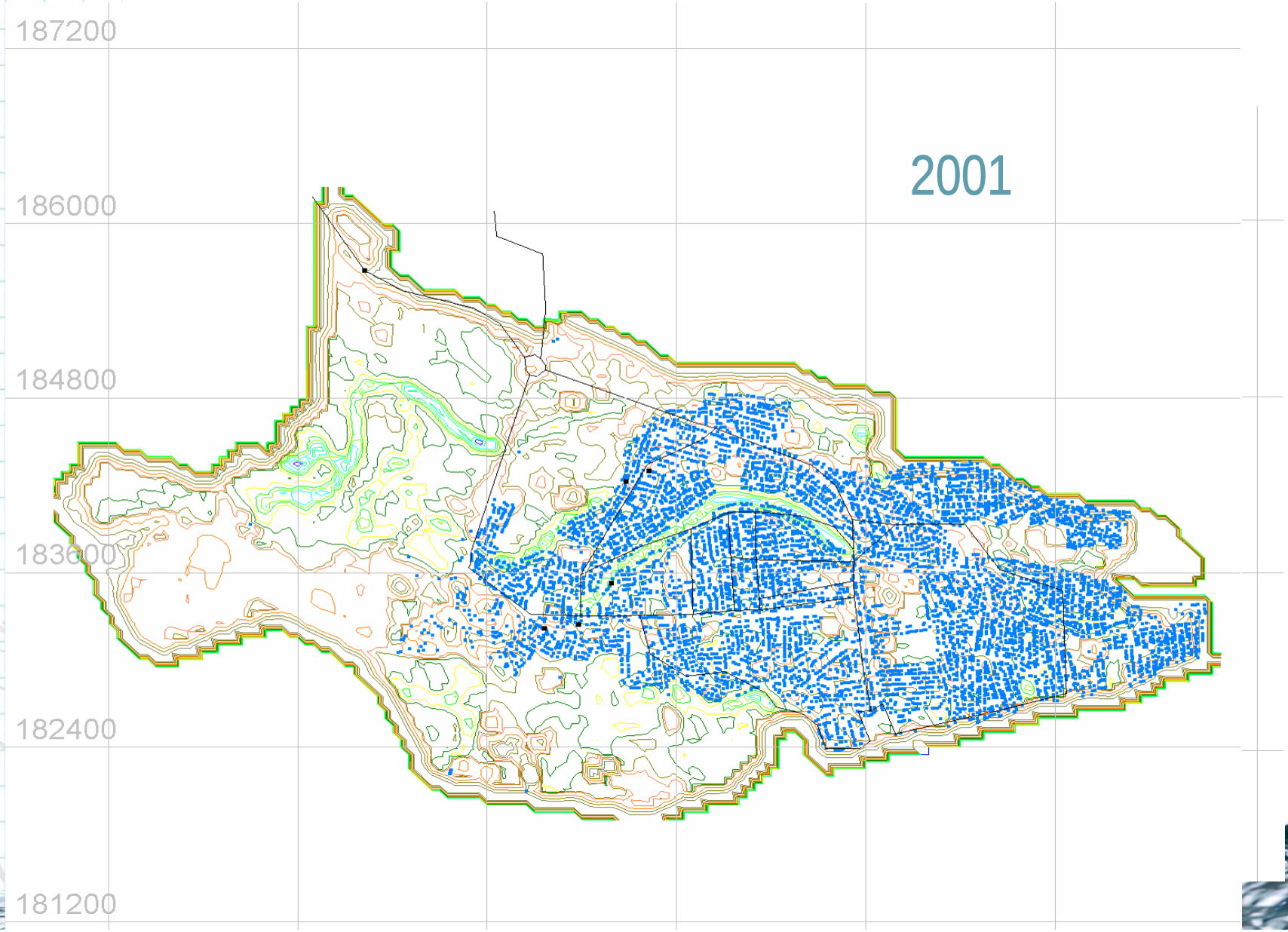
Canvey Island - Background

Maintenance of flood defences

Results for the modelled scenarios

- Approximately 37,000 people at risk on Canvey Island
- Approximately 15,500 buildings
- For design event between 350 and 400 fatalities (approximately 1% of the exposed population)
- Up to 2,000 buildings destroyed

Canvey Island – properties



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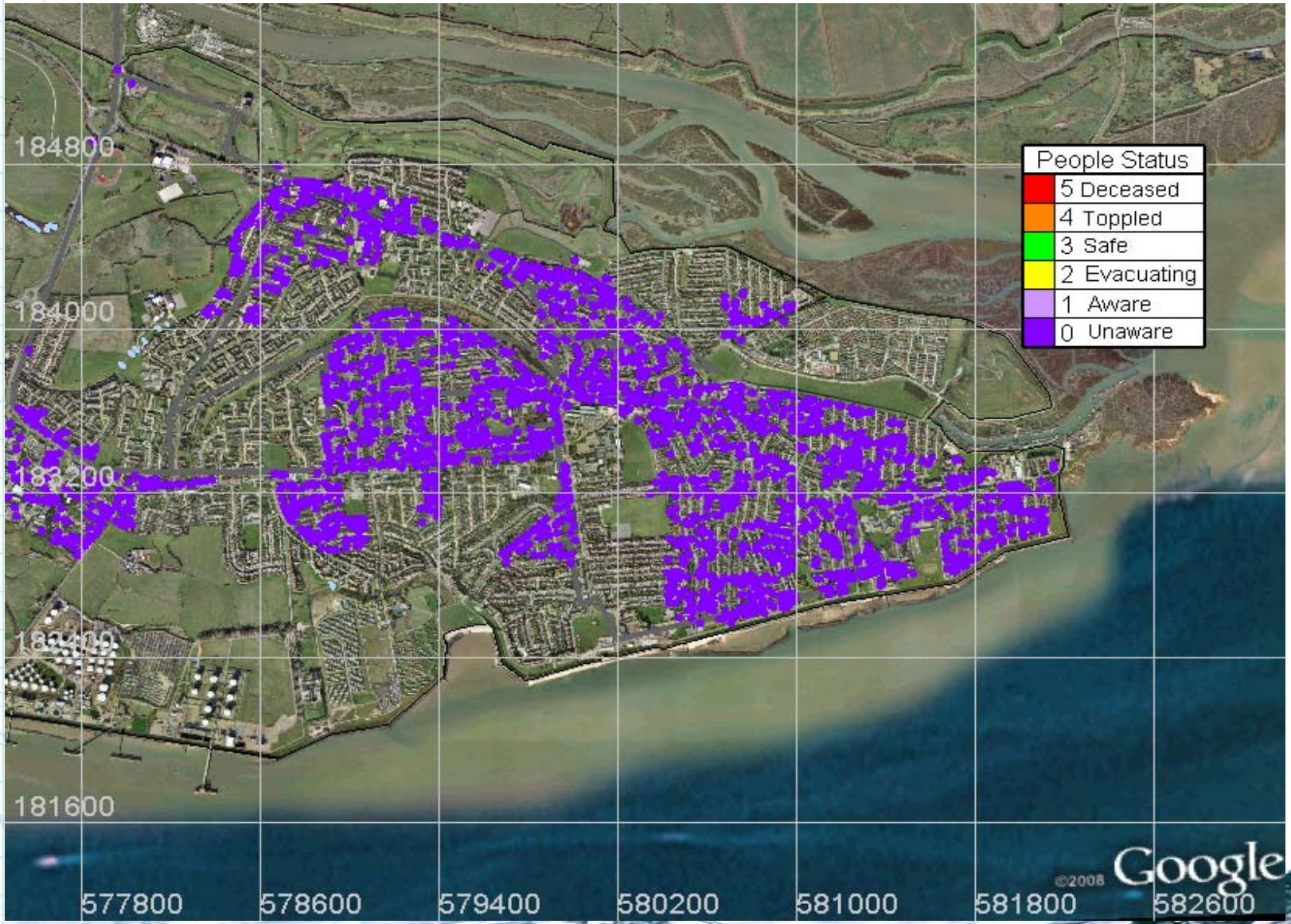
Canvey Island 1953 flood



Results of 1953 modelling

- Results agree well with historical data
- Modelling indicates 55 to 200 fatalities
- Around 55 fatalities as the result of drowning and 0 to 155 as the result of exhaustion and building collapsing

Use of the Life Safety Model

- Risk assessments for dams
- To inform emergency management plans
- To assess loss of life and injuries in a transparent manner from a variety of causes:
  - Drowning
  - Exhaustion
  - Building collapse
  - Cars being swept away
- To provide another measure of risk to assist in decisions related to the construction and maintenance of new and existing flood defence assets

Conclusions

- The LSM provides an evacuation modelling and loss of life tool that is sufficiently mature to support emergency planning and incident management
- Provides a more scientifically robust method for estimating loss of life than other methods previously used in the UK
- Could be used to improve emergency plans for heavily defended areas (e.g. London, some coastal areas) and dam risk assessments in the UK
- In future could be adapted to incorporate risks from other hazards e.g. toxic spills, nuclear accidents