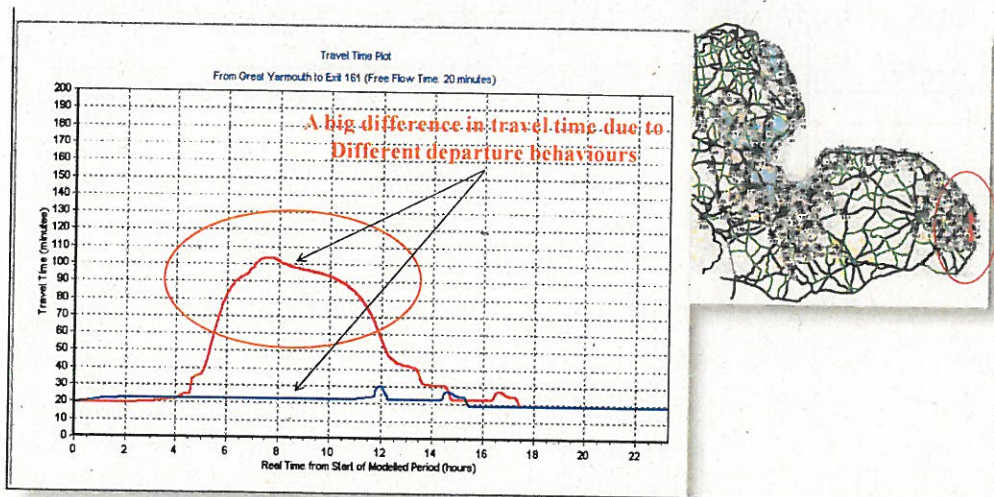


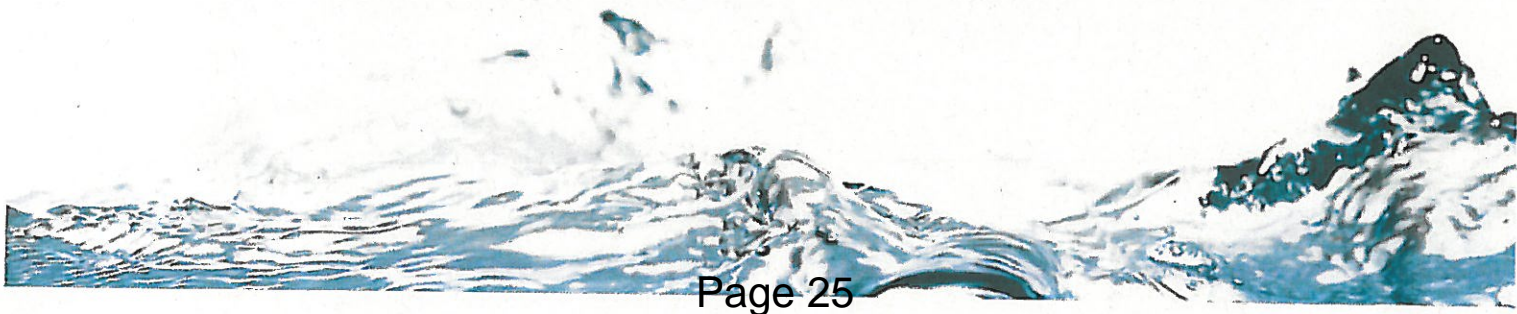
EX 6509

East Coast Flooding

The effective use of roads in Lincolnshire and Norfolk to evacuate people



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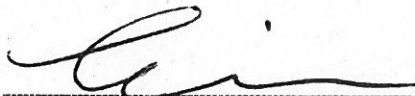
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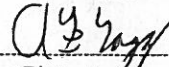
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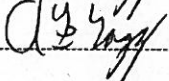
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Approved



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Summary

East Coast Flooding

The effective use of roads in Lincolnshire and Norfolk to evacuate people

Report EX 6509

The East coast of England faces a particular hazard from storm surge in the North Sea, such as occurred in January 1953. Combined with the low-lying nature of much of the land bordering The Wash, this means that the counties of Lincolnshire and Norfolk have some of the highest flood risk in the country. Evacuation is seen as an appropriate means to reduce loss of life and other impacts. However, the decision to evacuate will lead to significant disruption of business and family life, and require significant resources to facilitate the movement of people. Against this are the consequences in delaying the evacuation, which could mean that it is then not possible to evacuate everyone, that the evacuation is more chaotic and loss of life might result.

These issues highlight the need to understand better the logistical effort required to effectively and safely evacuate the public from high risk areas. One particular challenge is how well the road network will perform during an evacuation and the aim of this study was to investigate the effective use of roads for evacuation in Lincolnshire and Norfolk.

Traffic models were used to provide information for emergency planners to use in the development of evacuation plans. A tiered approach to modelling was adopted. A “macro” (large) scale model provided a representation of demand over the modelled time period, e.g. the peak traffic hour and total time required for evacuation. This can model large areas quickly, providing a first assessment and identification of possible congestion ‘hot-spots’. The “meso” (medium) scale model provided information on localised traffic problems and can be used to test specific options, which provide detail on the congestion across the whole road network.

Assumptions were made with regard to when people leave, how many leave, whether they all move at once or over a period of time. Two scenarios were modelled. The first, called the ‘*most likely*’ scenario described the situation where the evacuating population use the roads most frequently used or best known to them. This is a pessimistic scenario, where people leave by the nearest exit. The second scenario called ‘*optimised*’ described the situation where alternative routes to the scenario above are used by managing and directing the evacuating population to use more efficient routes, which improve the required evacuation time.

The outputs of the modelling provided maps showing where congestion may occur and the time required for an evacuation, including advice on management strategies such as the use of road signs to direct evacuees to take optimum routes to improve the flow of traffic. The report discusses how the maps can be used to determine if the congestion may compromise the travelling plans of critical infrastructure personnel and where the best locations for support services may be, including the best routes into the congested areas for these personnel.

In addition to these physical outputs, the report discusses less tangible influences such as the willingness to cooperate with evacuation plans, communication strategies (warning and informing the public), decision-making processes and events such as accidents or breakdowns.

In conclusion, the modelling has shown that it is advisable to put in place a traffic management strategy by directing people to specific exit points based on available road capacities. The report lists the improvements that can be made with regard to the amount of evacuation time required such as evacuating some people early and reassessing routes at a finer geographical level.

8.6 INFORMATION AND SIGNAGE PROVIDED DURING AN EVACUATION

The modelling work conducted as part of this study has recommended that a managed evacuation strategy with specific routes performs better than allowing people to follow their own or familiar routes. Therefore information on the routes to follow during an evacuation is critical to the efficiency of evacuation procedures; in particular this includes signage.

In their work on fire evacuation, Filippidis et al. (2011) highlight that there are a number of physical and psychological factors which influence the effectiveness of signage systems including: *“the visibility of a sign, the likelihood that the occupant will correctly comprehend the message being conveyed by the sign, and finally whether the occupant elects to follow the instructions conveyed.”*

Road signage is a common way of routing the public during an evacuation; however these may take many forms. The deployment of official personnel to direct traffic, temporary, permanent and electronic signs have all been used during evacuations to route the traffic and will all have their advantages and disadvantages.

The deployment of temporary signage to route traffic during an evacuation will depend upon whether there is enough time and personnel available prior to the need to begin the evacuation. In the case of the East Coast, this may depend upon the quality and lead time of the forecast. However, in reality the lead time, which has been modelled as being required to evacuate people from the flood zone, may mean that the possibilities for the deployment of signage before an evacuation will be limited. Temporary signs might of course be used in localised cases, if for instance the evacuation route needs to be changed due to particular circumstances.

The use of official personnel to direct traffic (in addition to either temporary or permanent signage) is, in most cases, more likely to lead to drivers following suggested routes than by using signs on their own. Although this may reinforce the signed messages and should be considered for major junction points where the routing of cars is critical, it will depend upon the availability of personnel (and may direct them away from other emergency activities such as flood warning and assisting the vulnerable) and will of course require people to be exposed within an area. As the modelling for the East Coast suggested that maintaining the exit routes is critical to the effectiveness of an evacuation, perhaps this is where emergency personnel should be best deployed to manage the traffic.

There are many examples of permanent signage utilised to mark evacuation routes for both hurricanes and tsunamis. These signs are often blue or brown and common features include (some examples of which are provided in Figure 8.6):

- Some indication of what hazard the evacuation is for (either in words, or symbols e.g. a large wave for tsunamis and a spiral symbol for hurricanes)
- That it is an evacuation route
- Some directional information (in many cases, arrows along routes, or for tsunami evacuation, the direction of the wave is where the higher ground is located)

Other signs just have the word shelter written on them and a directional arrow.

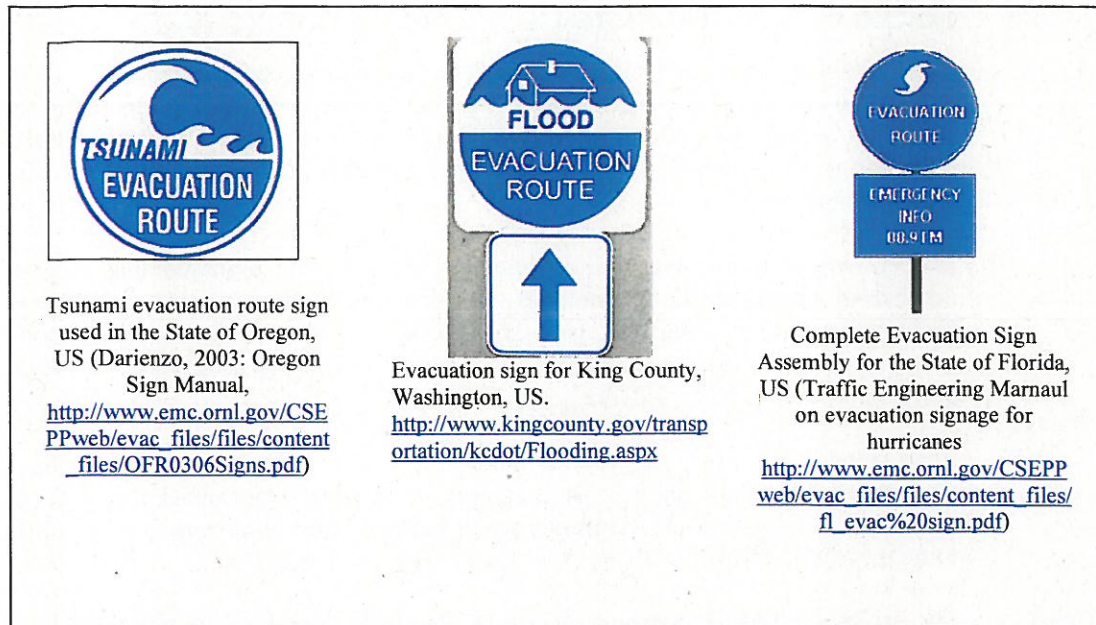
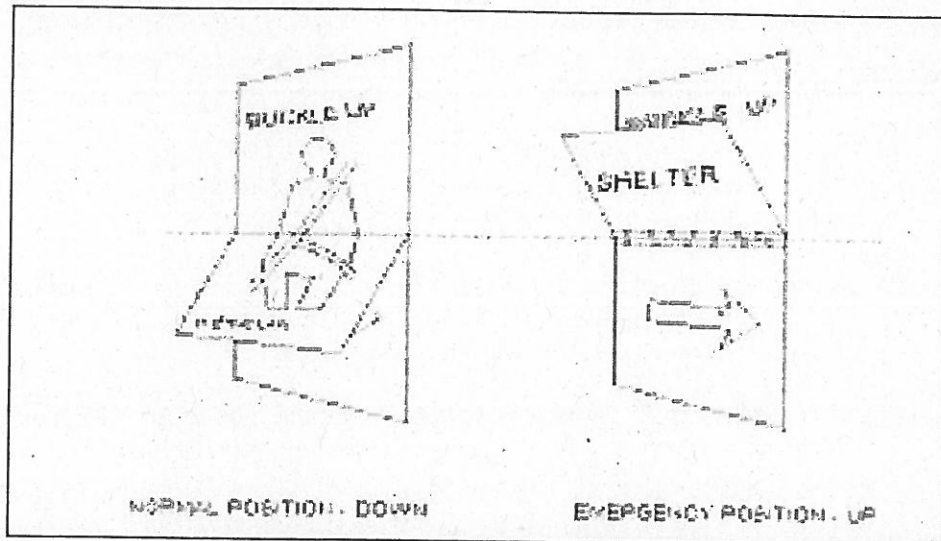


Figure 8.6 Examples of evacuation route signs

The clear advantage of permanent signs (and particularly considering the characteristics of the East Coast) is that they are considered to be useful for areas, which have a high percentage of transient or tourist populations where awareness of suitable routes may be low (Sorenson, 2006). They also may serve to be a reminder to the public that a flood risk exists, if they frequently have to pass clearly marked evacuation signs.

However, Darienzo (2003) suggests that a common issue with these types of signage is theft, which will obviously reduce the effectiveness of routing during an emergency. Additionally, if a section of the evacuation route becomes blocked for whatever reason, the use of permanent signage, which continues to direct road users into these areas will be problematic. This is one reason why some areas use flip signs, which are 'activated' at times of emergency. Figure 8.7 presents one such sign from the Florida *Traffic Engineering Manual on evacuation signage for hurricanes*, which have the added benefit that the sign can provide more general messages (such as the need to wear seat belts) at times of non-emergency. In the East Coast, for instance, there may be the possibility to use these signs to assist tourist traffic in seasonal conditions, however the dual positioning of such signs (to direct holiday traffic and evacuation traffic) would need to be carefully investigated. The use of this type of sign will, of course, also involve personnel and planning for 'flipping' them to show the emergency information, which will need to be done prior to the call for people to evacuate.



Accessed on 30.03.11, p6 from the following website document:
http://www.emc.ornl.gov/CSEPPweb/evac_files/files/content_files/fl_evac%20sign.pdf

Figure 8.7 Flip signs as illustrated by the State of Florida Traffic Engineering Manual on evacuation signage for hurricanes

Knowing the final destination of the route should also be considered to be important to whether or not evacuees follow designated routes for evacuation. This reinforces the importance of informing the public about the location of emergency shelters as part of pre and during-event information.

The importance of maintaining good communication during an evacuation cannot be overestimated. Providing information to the public during an evacuation procedure about any changes to routes or additional information is critical to an efficient and effective evacuation process. Many evacuation signs (as illustrated by one shown in Figure 8.6) also contain radio tuning information. This should definitely be considered for some of the signs, if adopted in the East Coast since maintaining communications with evacuating traffic, both within and once they have left the risk zone is essential.

