



A METHOD FOR ASSESSING THE VULNERABILITY OF BUILDINGS TO CATASTROPHIC (TSUNAMI) MARINE FLOODING



Project Description – August 2009

This project - a partnership between the Sydney Coastal Council Group (SCCG) and the University of New South Wales (UNSW), applied and tested a highly novel GIS tool to assess the vulnerability of coastal infrastructure to catastrophic marine floods - specifically, tsunami.

The project was coordinated by Geoff Withycombe from the SCCG and Associate Professor Dale Dominey-Howes from the Australian Tsunami Research Centre, UNSW. The Project Officer who undertook the research is Mr Filippo Dall'Osso, a coastal hazards and GIS expert from the University of Bologna, Italy. Mr Dall'Osso is currently doing a PhD on tsunami vulnerability assessment at the University of Bologna and works as a consultant for MED INGEGNERIA Srl, a leading Italian engineering company working on Integrated Coastal Zone Management and Hydraulics.



ELEMENTS OF THE RESEARCH PROJECT

Project background and aims

Sydney's low-lying coastal infrastructure is vulnerable to the impact of catastrophic marine floods associated with tsunami and storm surges. The future impacts of such floods will be worse than in the past because of climate related sea level rise and increased exposure at the coast. Coastal planners and risk managers need innovative tools to undertake assessment of the vulnerability of buildings and infrastructure and likely probable maximum loss located within their areas of responsibility. Such assessments will enable risk mitigation measures to be developed and challenges of long-term sustainability to be addressed.

The aim of this project was to apply a newly developed GIS vulnerability assessment tool to selected coastal suburbs of Sydney, evaluate and quantify the vulnerability of buildings at those locations to a hypothetical tsunami (or storm surge) flood based on the latest scientific understanding.

Selected study areas and inundation scenario

The GIS model was applied at two study locations within the Sydney Coastal Council Group area: Maroubra Beach (Randwick Council) and Manly Ocean Beach (Manly Council). The inundation scenario we adopted is a locally generated submarine landslide tsunami achieving a run-up of +5 metres above maximum tide level (+2m asl). Such tsunami are the most likely to occur in the Sydney region.

Project method

Stage 1: Upgrading the PTVA Method

Our approach is based on an existing method for assessing the vulnerability of buildings to tsunamis: the "Papathoma Tsunami Vulnerability Assessment (PTVA) Model". The PTVA Model was developed using detailed information about the impacts of historic tsunamis and the results of numerous post-tsunami surveys and building damage assessments (Papathoma, 2003; Papathoma and Dominey-Howes, 2003; Papathoma *et al.*, 2003). We used the PTVA Model as the starting point in this study (for further information see Dall'Osso, F. and Dominey-Howes, D., 2009: "A method for assessing the vulnerability of buildings to catastrophic (tsunami) flooding". Available at: <http://www.sydneycoastalcouncils.com.au>)

Stage 2: Building the GIS

To undertake the vulnerability assessment, a GIS database was constructed. The database included a set of georeferenced aerial photographs and a high resolution DEM (digital elevation model).

A total of 96 buildings in Maroubra and 1133 in Manly were manually digitized onto the aerial photographs within the GIS. Next, we collected attribute data for every building during field surveys and inserted these data in to the GIS.





Stage 3: Running the model

The model calculated a Relative Vulnerability Index (RVI) score for every building that would be touched by flood-water associated with the scenario we investigated. RVI scores were calculated based upon a combination of building physical features, building surroundings, and exposure to inundation.

Results and Discussion

Results are presented via a series of thematic vulnerability maps, in which different types of buildings are displayed using a colour code corresponding to the RVI score.

The maps show two very different situations for Maroubra and Manly. Because of its higher average topographical elevation, the inundation at Maroubra would cover only 27 Ha, while 169 Ha would be flooded in Manly. As a consequence, only 96 structures would be touched by the tsunami in Maroubra, with a maximum water depth of 3 metres. No structures were found to have a 'Very High' RVI score.

At Manly, a total of 1133 buildings would be inundated, and the water depth above ground surface would reach a maximum of 7 metres in the lagoon area. The tsunami would also be able to flow through the Corso and reach the Manly Wharf on the harbour side. RVI scores showed that a large number of residential and commercial structures are highly vulnerable to damage and most of them are located in the area next to the lagoon. Also, a number of Local Government and transport sector structures were assessed as being very vulnerable to damage from the tsunami.



RVI scores of inundated buildings in Maroubra



RVI scores of inundated buildings in Manly

We have used the results of the analysis to outline a series of recommendations for further research and for land-use zoning, the development of building standards and codes and in the development of tsunami emergency risk management strategies.

Project Outcomes

The project has delivered the following:

1. 1:5000 scale maps of the RVI scores of all buildings within the two study areas
2. A report including a detailed description of the method, the results and a series of potential recommendations for Government(s) to increase their capability to deal with long-term risk mitigation
3. A step by step ArcGIS user's manual for applying this model to other coastal areas including a specific tool to be installed onto the GIS platform.

Project Management

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