



DEVELOPING A G.I.S. TOOL TO ASSESS VULNERABILITY TO CATASTROPHIC MARINE FLOODS IN SYDNEY



Project Description – February 2008

The Sydney Coastal Councils Group (SCCG) has partnered with the University of New South Wales to undertake a research project that will apply and test a newly developed and highly novel GIS tool to assess the vulnerability of coastal infrastructure to catastrophic marine floods. The outputs may be used by council to make decisions about long-term strategic planning and development. The project will be coordinated by Geoff Withycombe from the SCCG and Associate Professor Dale Dominey-Howes from the School of Risk and Safety Sciences, UNSW. The Project Officer who will undertake the research is Mr Filippo Dall'Osso, a coastal hazards and GIS expert from the University of Bologna, Italy who is currently based at UNSW. The project will be completed by the end of May 2008.



ELEMENTS OF THE RESEARCH PROJECT

Project background and aims

Sydney's low-lying coastal infrastructure maybe potentially vulnerable to the impact of catastrophic marine floods associated with tsunamis 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 is to apply a newly developed GIS vulnerability assessment tool to selected coastal suburbs of Sydney, evaluate and quantify the potential vulnerability of structures at those locations to a hypothetical tsunami flood based on the latest scientific understanding, produce maps to display the spatial distribution of vulnerable structures at a scale of 1:5000, to make recommendations about possible risk management strategies at those locations and to provide a tool kit for local government to undertake vulnerability assessment themselves.



Selected study areas and inundation scenario

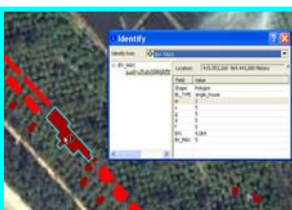
With data and support provided by councils, the GIS model will be applied to and tested upon two specific study areas: Maroubra Bay (Randwick Council) and Manly Ocean Beach (Manly Council). The scenario that will be used as the boundary condition to run the vulnerability assessment is a locally generated submarine landslide tsunami achieving a run-up of maximum height of +5 metres above sea level. Such tsunamis are the most likely to occur in the Sydney region. Whilst a tsunami is a low probability event, the consequences would be significant.



Project method

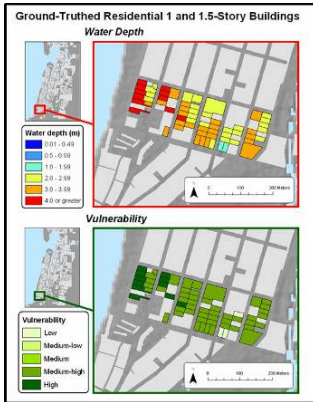
Stage 1: Building a GIS database

To undertake the vulnerability assessment, a GIS database is constructed. The database includes for each study area: georeferenced aerial photographs, land surface elevation data, land use, geomorphology, the distribution of buildings and a number of characteristics for each building. Data about each of these factors are used in the assessment because it is known that these control the actual vulnerability of structures to flood damage.



Stage 2: Running the model: the multi criteria analysis

The vulnerability of an individual building or infrastructure unit is based on the relative contribution of a range of physical and environmental factors. These factors are not equal in their importance. The vulnerability assessment tool to be used in this project is based on the use of a simplified version of the Analytic Hierarchy Process (AHP), which is a multi-criteria technique for decision making, developed to balance the performance of many possible solutions to a given problem. The AHP will be used here to weight the different factors that affect building and infrastructure vulnerability to marine inundation. The AHP uses a rigorous mathematical approach.



Expected Outputs

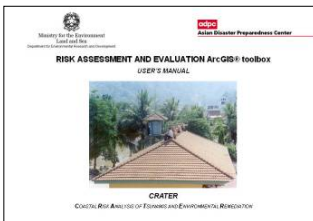
As output, the model will calculate a numeric level of vulnerability, ranging from 1 (low) to 5 (high), for every single building and infrastructure unit located within the inundation zone of the scenario. These values will be automatically stored in the GIS database, and associated corresponding structures. By means of the GIS, buildings and infrastructure will be plot on to maps, using different colours for different vulnerability levels.



Project Deliverables

The project will deliver (subject to data availability) the following:

1. Successful trailing of the GIS modeling software within the Sydney context
2. 1:5000 scale example maps of the exposure of all buildings and infrastructure units within the hypothetical (tsunami) flood zone;
3. 1:5000 scale map of the hypothetical vulnerability of all buildings and infrastructure units within the flood area;
4. A series of potential recommendations for Government(s) to increase their capability to deal with long-term risk mitigation. These recommendations might focus on future land use zoning, building guidelines and regulations, future vulnerability, emergency management procedures and loss under climate change conditions and the implications for sustainable development and so forth ; and
5. A step by step ArcGIS user's manual for applying this model to other coastal areas including a tutorial exercise for non professional GIS users. The manual will include steps such as: data needs and collection, establishment of the GIS database and its various fields, validation and ground-truthing data, generating vulnerability maps and updating the database.



The map outputs from this project will be specific to the study areas of Manly and Randwick but very importantly, the 'method' used will also be an output that may be utilised by all local government areas and member councils of the SCCG.

Project Management

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