THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Human Sciences Building 201
Level 6, 10 Symonds Street
Auckland, New Zealand
T +64 9 923 8440
W auckland.ac.nz
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PEER REVIEW
Hawke Bay Coastal Strategy – Coastal Hazard Inundation Assessment

Hawke's Bay Regional Council (HBRC) commissioned a peer review of the report titled *Hawke Bay Coastal Strategy Coastal Hazard Assessment* produced by Tonkin and Taylor. The erosion hazard component of the report has been reviewed previously. This review examines the inundation component of the hazard report and subsequent inundation mapping.

Section 5.0 of the report outlines the methodology adopted to assess coastal inundation hazards. The assessment of inundation is presented in two parts.

1. ***Permanent inundation:*** This analysis examines areas of the coast subject to permanent inundation as a consequence of astronomical tidal processes (in particular highest astronomical tide) and sea level rise. The report adopts sea level rise scenarios of 0.5 m and 1.0 m for the 2065 and 2120 time horizons. The combination of sea level and astronomical tide heights are summed and related to coastal topography to determine the areas of the coast subject to permanent inundation using a bath tub approach.

2. ***Extreme inundation:*** This analysis refers to areas of the coast subject to periodic flooding as a consequence of astronomical tides together with super elevation of water level driven by storm surge and related wave processes (wave setup and runup). The methodology utilises XBeach-G a model primarily constructed to examine beach morphological dynamics in response to incident storm hydrodynamics. Of note, the model has been validated in scientific studies and has shown a good level of performance in predicting wave transformation processes, run-up levels and wave overtopping on gravel beaches (McCall et al., 2014). Notwithstanding the textural differences between pure gravel beaches (upon which the model was developed) and mixed sand and gravel beach system in Hawke's Bay the application of XBeach-G to assess extreme inundation is sound. In the context of the Hawke's Bay hazard assessment, use of the model is also logical as it formed the basis of the erosion modelling. Significantly, outputs of XBeach-G runup levels are compared with previous estimates from Komar and Harris (2014) and are found to show reasonable correspondence. Consequently, I consider the work has demonstrated the validity of the approach to assess inundation in the Hawke's Bay. Indeed model outcomes are also compared with empirical observations (Goodier and Pearse, 2015) and show reasonable correspondence.

   In summary, I consider the inundation analysis adopts a robust methodological approach, which forms the basis of inundation mapping.

   Extreme inundation evaluated three discrete water levels, the 10% AEP, 1%AEP and 0.5% AEP. Mapping of inundation zones was based on the manual integration of the extreme water levels along the coast produced by XBeach-G with the inundation extent resulting from overtopping from the catchment flood models of HBRC using engineering judgment to refine the inundation maps. Further commentary provided by Craig Goodier indicated the localized decisions taken in preparing

the hazard inundation maps. While the methodology to estimate inundated areas is adjusted between sites, I consider this is a sound process based on ground-truthed empirical nuances of each locality. The ensuing inundation maps provide informative products that highlight areas of the coast subject to inundation.

General comments

- I believe the report and its findings are robust given the current state of knowledge of coastal science and the methodological tools available to evaluate inundation hazards.
- There appears to be a disparity between Table 6-2, which shows overtopping as grey cells and Tables 6-3 and 6-4 which do not highlight overtopping despite extreme water levels exceeding those in Table 6-2.
- The report selects only two future sea level rise scenarios to develop inundation analyses. It is recommended that future work seek to explore a more complete spectrum of sea level rise scenarios, joint probabilities and changing inundation frequencies. Such information would be useful to highlight threshold water levels that cause major impacts on communities and the changing frequency of flood events.
- The report divides the coast into discrete compartments centered on established coastal profiles. This is logical and allows variations in coastal topography to be evaluated. The outcome of this approach is to yield spatial differences in flood hazards which realistically reflect variations in coastal configuration.
- Inundation analysis adopts a relatively new model specifically developed to assess gravel beach hydrodynamics and beach dynamics. Gravel beaches are known to behave differently to typically sand beaches and consequently, it is refreshing to see this new model applied to Hawke's Bay.
- Ultimately, inundation analysis was performed using a bathtub approach on the 2003 LiDAR DEM, which is commonly used in flood analyses but does have limitations with respect to future scenario assessment. The bathtub approach assumes that the coastline is geomorphically static. The recent erosion hazard assessment undertaken by HBRC indicates this is not likely to be the case, with coastline changes projected over the next century. Such changes would impact future flood analysis scenarios. While this is not to imply the approach is inappropriate, such geomorphic changes will alter the flooding results into the future. In future it would be instructive to examine how the erosion and flood assessments could be coupled to allow the shifts in the geomorphic template to feed back into flood analyses.

In summary, the report is a well-considered analysis of inundation hazards along the study coastline. It adopts a novel modelling approach combined with ground-truthed local knowledge to present areas subject to inundation. While further work can always be undertaken to refine and improve understanding of future flood hazards, their frequency and the associated risks, I consider the findings provide a baseline dataset, which is appropriate for informing hazard management strategies in the study area.

References

Goodier, C. and L. Pearse (2015) Storm report: Cyclone Pam, March 15-18, 2015. HBRC response to Cyclone Pam, HBRC Report No. 4728, Plan No. AM15/03.

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Professor Paul Kench