

Appendix M: Sea Level Rise on Rocks Road

TO: Phil Peet

DATE: 23 July 2010

CC:

REF:

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SUBJECT: Sea Level Rise on Rocks Rd, Nelson

The following details a simple assessment of how inundation and flooding of Rocks Rd by sea water may increase due to the predicted effects of climate change.

Information is known on the existing sea level, predicted sea level rises due to climate change, and storm surge. The unknown factor is wave set-up and run-up height which will undoubtedly have a major effect on overtopping onto Rocks Rd. An accurate assessment of wave set-up and run up height requires an experienced coastal practitioner and possibly wave action modelling.

Storm Tide Analysis

A number of spot elevation levels along Rocks Road have been supplied – notably three points at elevations of 3.5m, 3.8m and 4.0m. These levels are in terms of the Nelson Vertical Datum (NVD-55).

A recent report prepared for Nelson City Council by NIWA, *Review of Nelson City minimum ground level requirements in relation to coastal inundation and sea level rise* (August 2009), presented analysis and results of predicted sea level rise in Nelson due to climate change. NIWA (2009) use the Port of Nelson tide level recorder as the basis for analysing current sea level and predicted future sea levels. This site is very appropriate to the Rocks Rd area. The level at this recorder is measured in terms of Chart Datum (Port of Nelson). The tide data record has been obtained for analysis.

For comparison to sea levels, the three spot elevations on Rocks Road are converted to Chart Datum.

Chart Datum at Port Nelson is 2.31m below mean sea level (as detailed by NIWA, 2009) and 2.24m below NVD-55. NVD-55 was actually based on mean sea level measurements from 1939 to 1942 and since that time sea levels have risen 0.07m in relation to NVD-55. NVD-55 is used by Tasman District Council for defining ground elevations.

Three different predicted levels of sea level rise for 2100 are assumed: 0.5m, 0.8m, and 1.0m – as recommended by NIWA (2009). The 0.5m and 0.8m sea level rises are based on the MfE guidance manual. These are “storm-tide” levels so storm surge is accounted for within the predicted rise.

Uncertainties in predictions and the possibility of faster than expected ice melt from the Antarctica and Greenland ice sheets lead to a sea level rise of 1.0m by 2100 being considered (NIWA 2009).

Table 1 details the three levels on Rocks Rd converted to Chart Datum and adjusted for the three predicted increases to sea level. Wave set-up and run-up height are **not** accounted for in Table 1. The average recurrence intervals (ARI, or return period) in years are interpreted from the NIWA (2009) report.

Under current sea level conditions the likelihood of the sea level inundating the three Rocks Rd locations is in excess of 100-years ARI. As mentioned above this **does not** include wave set-up and run-up, it purely details the increase in storm-tide levels. A predicted 0.5m sea level rise would result in the lowest level of Rocks Rd (3.5m NVD-55 or 5.74m CD) being exceeded on average once every 25 years. A sea level rise of 0.8m would result in annual exceedence.

Table 1

Rocks Rd Level (m NVD-55)	Converted to Chart Datum (m)	Average Recurrence Intervals (Years)			
		Current	0.5m rise	0.8m rise	1.0m rise
3.5	5.74	100+	25	Annual	Annual
3.8	6.04	100+	100+	30	2
4.0	6.24	100+	100+	100+	30

Assuming a Wave Height

Wave set-up and run-up height is likely to be a major contributing factor to the inundation of Rocks Rd, particularly in conjunction with a high/extreme tide level.

It appears there has been no previous assessment of wave action in this area, and if accurate predictions of the impact of sea level rise on Rocks Rd are required then it is recommended such an assessment be completed.

Evidence suggests that Rocks Rd suffers from flooding inundation from the sea about two times per year. This can be used to complete a simple assessment to understand how this frequency may increase due to predicted sea level rise.

Two occurrences, or days, per year equates to 0.5% of the time. Analysing the recorded tide levels at Port Nelson, the sea level that occurs 0.5% of the time is 4.5m (CD).

The lowest level provided for Rocks Rd is 5.74m (CD), so a wave set-up and run-up contribution of 1.24m (5.74m minus 4.5m) can be assumed if the sea level is to exceed this point. With no information on wave set-up and run-up in the area the same 1.24m is assumed for the following results:

- If a 0.5m sea level rise occurs, then the tide level will exceed 4.5m and the total sea level will exceed the point on Rocks Rd for 3% of time, or **11 days per year**
- If a 0.8m sea level rise occurs, then the tide level will exceed 4.5m and the total sea level will exceed the point on Rocks Rd for 6.5% of time, or **24 days per year**
- If a 1.0m sea level rise occurs, then the tide level will exceed 4.5m and the total sea level will exceed the point on Rocks Rd for 14% of time, or **51 days per year**

This is a simplistic analysis and the occurrence of inundation is likely to be more frequent as smaller (and therefore more frequently occurring) wave set-up and run-up events will be required to overtop the road as sea level rises. This does, however, shows how the frequency of inundation would increase given a certain wave action.