Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Memo

Date	
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CC	
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Timaru High Hazard Area – Coastal Hazards

1. Background

Recently completed coastal hazard assessments for the Timaru District present a range of potential future shoreline positions, and areas of potential coastal inundation based on current and future sea level scenarios. One of the key outputs of the coastal hazard assessments are “hazard maps” based on these potential future scenarios. These maps help build an understanding of the nature of the hazards and their potential physical impacts. The assessments were undertaken for the purpose of guiding decision making for land use and asset planning and future coastal management. The maps can be used to help develop and test possible hazard management options.

Timaru District Council have requested advice on determining how the science in the Timaru coastal erosion and coastal inundation assessments relates to the high hazard definition in the Canterbury Regional Policy Statement (CRPS), Policy 24 of the New Zealand Coastal Policy Statement (NZCPS) and the Ministry for the Environment’s coastal hazards and climate change guidance for local government (MfE 2017). These documents all contain important direction, guidance and considerations when identifying areas exposed to or potentially affected by coastal hazards.

Coastal hazard assessments are not risk or vulnerability assessments. The purpose of a coastal hazard assessment is to identify the spatial extent and magnitude of hazards, and to quantify, if possible, the likelihood of hazards occurring. The Timaru coastal hazard assessments do this by mapping areas of the district that could potentially be exposed to coastal erosion and coastal inundation.

A vulnerability assessment assesses the potential of assets (public and private) and people (including the things they value) to be affected by exposure to coastal hazards and sea level rise (MfE 2017). A vulnerability assessment also takes into consideration a community’s ability to adapt to coastal hazard risk.

A coastal hazard risk assessment assesses the likelihood of the impact of the coastal hazard combined with the consequences of that impact. Vulnerability assessments and risk assessments are often carried out together and assess the exposure and vulnerability of people and assets to coastal hazards (MfE 2017).

2. Policy 24 New Zealand Coastal Policy Statement

Policy 24 of the New Zealand Coastal Policy Statement (NZCPS) (2010) directs Councils to:

"*Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected."* Hazard risks over at least 100 years are to be assessed taking into account national guidance and the best available information on climate change.

Policy 24 directs these assessments to have regard to a number of physical factors including physical drivers and processes that cause coastal change (including sea level rise); short and long term natural erosion and accretion cycles; the geomorphology of the coast; inundation sources and pathways; cumulative effects of sea level rise, storm surge and wave heights under storm conditions; human influences on the coast and the overall effects of climate change on these physical processes. Policy 24 also states that hazard risks over at least 100 years should have regard to the "extent and permanence of built development".

The sea level rise scenario-based coastal erosion and inundation hazard assessments prepared for the Timaru District satisfy the requirements of Policy 24 in that they map a range of scenarios that cover areas that are "potentially affected", albeit with varying degrees of likelihood. Even if something is very unlikely to occur, there is still the potential for it to do so.

The completed assessments also have regard to the physical drivers and processes required in the Policy and assess these under a range of climate change/sea level rise scenarios over the next 100 years. As the coastal erosion and inundation hazard assessments are not risk assessments, they do not include an analysis of the extent or permanence of the built environment (Policy 24 (1)(g)). The extent and permanence of built development will not have a significant effect on the coastal hazard (in terms of the likelihood or extent of erosion or inundation) but could have a large impact on the potential consequences of an event and ultimately the long-term risks. Determining the long-term risks and consequences to and on the built environment, including various land uses and building types could be addressed in a risk assessment.

3. Ministry for the Environment Coastal Hazards and Climate Change Guidance

3.1 Coastal hazard assessment approach

Ministry for the Environment Guidance for local government (MfE 2017) contains details about how to apply a risk based, adaptive planning approach (Dynamic Adaptive Pathways Planning (DAPP)) to coastal hazards and climate change. Although focused on providing Councils with guidance on how to undertake an adaptive pathway planning approach, the Guidance includes advice and direction on the appropriate science and technical information that should be incorporated into a coastal hazard assessment. The information from the hazard assessment can be used as part of a suite of information to inform and guide the DAPP process.

The Timaru coastal hazard assessments were prepared at a level described as "detailed hazard assessments" in the MfE Guidance. Detailed assessments require a thorough understanding of coastal processes and the effects of different future sea level rise scenarios, and the uncertainties of both.

The MfE (2017) guidance recommends either direct usage of RCP scenarios, or increments of sea level rise to inform hazard assessments. The guidance also recognises that local authorities may not be in the position yet to embark on an adaptive planning process for making coastal land use and other adaptation decisions, so also allows for the use of single "transitional" sea level rise values at a local or district scale. The Timaru coastal hazard assessments use increments of sea level rise to demonstrate the relative erosion and inundation exposure of the Timaru coast to incremental increases in sea level rather than single values. However, the 0.2m incremental sea level rise scenarios used in the Timaru assessments can be broadly aligned with the single transitional sea level rise values in the guidance.

3.2 Transitional sea level rise values

The guidance recognises that many Councils will not be in the position to undertake, or transition to a full coastal adaptive planning programme of works, so provides advice on single minimum "transitional" sea level values for use in planning instruments where a single value is required at local/district scale. Minimum transitional SLR allowances are provided for use in planning processes for four broad categories of development;

1. Greenfields development, subdivision, major new infrastructure (Category A)
2. Intensification i.e. changes in land use and redevelopment (Category B)
3. Controls for existing coastal development and assets planning (Category C)
4. Non-habitable short-lived assets with a functional need to be at the coast (Category C)

For Category A (Greenfields development) the guidance advises using sea-level rise over more than 100 years and the RCP H+ scenario.

For Category B (intensification) the guidance recommends that a full dynamic adaptive pathway planning approach should be undertaken using SLR scenarios before intensification takes place to avoid compounding further risk.

For Category C (existing development) the guidance recommends using a minimum transitional value of 1m SLR.

For Category D (non-habitable, short-lived coastal assets) a minimum SLR value of 0.65m is recommended.

3.1 Erosion

For erosion, the guidance suggests a detailed hazard assessment should include a thorough understanding of the storm erosion potential at individual sites, long-term trends and the potential for a range of climate change scenarios to modify these processes. The various components should be combined probabilistically so that the resultant values are statistically robust (MfE 2017). A long history of previous coastal investigations and collection of coastal monitoring data in the Timaru District has enabled the assessment of future coastal erosion to include all the required components of a detailed probabilistic hazard assessment and to align the probabilistic assessments with future timeframes out to 2070 and 2120.

3.3 Inundation

For a detailed inundation hazard assessment MfE Guidance suggests the various astronomical tide, storm surge and wave processes should be assessed and combined probabilistically and recommends using the1% annual exceedance probability and upper 95th percentile confidence interval for hazards.

The inundation modelling for Timaru has modelled both a 2% AEP and 1% AEP event and uses a 95% confidence interval for wave heights (significant wave height). Forcing the inundation model using the 95th percentile wave heights is conservative but removes the need for including any additional safety factor (i.e. freeboard) to the model results. It infers that it is very unlikely that a 1% AEP event will be above this level.

1% AEP refers to a 1% chance of an event occurring or being exceeded in any year. So, it is a large and rare event on an annual basis, but increasingly likely over longer timeframes e.g. such an event would have a 63% chance of occurring at least once over a 100-year timeframe.

A 1% AEP coastal storm event is a useful benchmark because it uses all sea-level processes and is rare on an annual basis but becomes more likely over a planning timeframe (MfE 2017). A 1% AEP event at current sea levels may be rare but with sea level rise the level of flooding experienced in a 1% AEP event under current sea levels will occur on a much more regular basis.

As sea levels rise, the area of land potentially affected by a 1% AEP storm event will increase. By adding the 1% AEP storm to increments of sea level rise the inundation assessment gives an idea of future potential areas exposed to storm inundation under a range of future sea level scenarios. The scenarios can be related to a range of future timeframes for when those sea levels might be expected to occur depending on future greenhouse gas emissions.

Unlike the coastal erosion assessment, the inundation modelling scenarios do not include a planning timeframe (i.e. 2070 and 2120). However, the sea level rise increments (0.2, 0.4, 0.6, 0.8, 1.2, 1.5m) can be roughly aligned with future time horizons (or future planning time horizons) and RCP emissions scenarios. For example, an 8.5 RCP “business as usual” emissions scenario of 0.2m SLR would be reached around 2040, 0.8m SLR around 2100 and 1.2m SLR around 2130. For a 4.5 RCP (i.e. reduced emissions) future, 0.2m, 0.8m and 1.2m SLR would be reached around 2040, 2140 and 2200 respectively (MfE 2017, Table 10 and 11). Therefore, by adding sea level rise increments to a modelled 1% AEP storm, the present-day 1% AEP storm event is transformed into a similar probability inundation hazard event that could apply at the end of a particular timeframe if the highest potential sea-level rise scenario has eventuated by then, or some time later as the sea level continues to rise (DOC 2017). So as an example, the modelled 1% AEP storm with 1.2m of sea level rise (and assuming a future high emissions scenario), is the possible extent of that storm if it occurred around the year 2130.

4. Canterbury Regional Policy Statement – High Hazard definition

The Canterbury Regional Policy Statement (CRPS) seeks to achieve the avoidance of the potential effects of natural hazards, including coastal hazards, in “high hazard areas”. For coastal hazards (coastal erosion and coastal inundation), the CRPS defines high hazard areas as; land subject to coastal erosion over the next 100 years; and land subject to sea water inundation over the next 100 years. The effects of climate change need to be considered when determining high hazard areas.

The CRPS high coastal hazard definition is open to interpretation. The scenarios presented and mapped in the Timaru coastal hazard assessments all identify land that may be “subject” to coastal erosion and/or inundation over the next 100 years, albeit with different likelihoods or timeframes within or around that 100 years. Therefore, both the timeframe and exposure components of the CRPS definition are satisfied by each of the many erosion and inundation scenarios in the assessments.

The coastal high hazard area CRPS definition does not have a risk element as it does not consider consequences. It defines the spatial extent of land that may be subject to coastal erosion and inundation hazard.

5. Identification of high coastal hazard areas

Timaru District Council would like to map coastal high hazard areas for erosion and inundation in their draft District Plan. This requires some direction as to which of the erosion and inundation scenarios is most appropriate. With such a broad CRPS definition, I also need to consider the other coastal hazard guidance and policy direction outlined in Sections 2 and 3.

5.1 Erosion high hazard area

For coastal erosion hazard, the Timaru District coastal hazard assessment identifies areas in the district that may be exposed to coastal erosion within the next 50 to 100 years using a range of sea level rise scenarios. The report considers the potential changes to the position of the Timaru District shoreline:

- Over a 50-year period from 2020, using three sea level rise scenarios (0.2m, 0.4m, 0.6m) and;
- Over a 100-year period from 2020, using four sea level rise scenarios (0.6m, 0.8m, 1.2m, 1.5m)

For each of the timeframes and sea level scenarios a potential future shoreline is identified using two probability thresholds; “most likely” (a shoreline position with a 50% probability of being reached or exceeded) and “very unlikely” (a shoreline position with a 5% probability of being reached or exceeded). Although the 5% probability position is still statistically possible and includes the “potentially affected” areas that the NZCPS directs Councils to identify (section 2), I consider the 5% probability future shoreline position, particularly including the inherent uncertainties outlined in the technical report out to the 100 year timeframe to be overly conservative for defining high coastal erosion hazard areas. Even at the end of a 100-year timeframe it is unlikely that the shoreline will erode to this position.

Therefore, a more appropriate probability to apply to identify a high coastal erosion hazard area is the most likely (50%) future shoreline position. I would also recommend applying the 1.2m sea level rise scenario combined with the 50% probability scenario, as the 1.2m reflects the current “business as usual” RCP 8.5 projections along which global greenhouse gas emissions and sea level rise seem to be currently tracking. Based on the probabilistic assessment this is the likely position of the shoreline at the end of the 100-year planning period under a high greenhouse gas emissions future. These areas may not be high erosion hazard areas now but may be in the future as erosion continues and is exacerbated by rising sea level. The 1.2m SLR value also roughly aligns with the Category C transitional sea level rise of 1m for existing development recommended in the MFE national guidance.

5.2 Coastal inundation high hazard area

The assessment identifies nine potential coastal inundation areas in the Timaru District, based on:

- A 1% annual exceedance probability (AEP) storm (being a 100-year annual recurrence interval (ARI) storm event), combined with seven sea level scenarios (current sea levels, +0.2m, +0.4m, +0.6m, +0.8m, +1.2m and +1.5m) and;

- A 2% AEP storm (being a 50-year ARI storm event), combined with two sea level rise scenarios (+0.4m and +0.6m).

The modelled inundation from a 1% AEP storm does produce a significant amount and depth of inundation in some areas, even under current sea levels. It is a low probability event, but it does have the potential to cause significant effects – mainly to buildings, infrastructure and productive land. Risk to life is low, as potential coastal inundation events are generally forecast and warnings can be made, and inundation generally happens slowly and at a low velocity away from the immediate wave breaking and wave runup zones.

I would suggest that at a minimum a high hazard inundation area should include the modelled 1% AEP inundation area at present day sea levels. The CRPS requires a consideration of climate change when determining high hazard areas, and the coastal inundation assessment does presents a range of sea level rise scenarios that could occur within the CRPS 100-year timeframe.

For consistency with the erosion high hazard the 1.2m sea level scenario could be applied to the 1% AEP storm inundation. This would also roughly align with the transitional guidance for existing development of using 1m of sea level rise.

As their hazard and risk profiles are quite different, high coastal erosion hazard areas and the high coastal inundation hazard areas should be treated and mapped separately. Storm inundation is a temporary flooding hazard that might span a few days or even just a few hours around high tide as opposed to coastal erosion which is a permanent and inexorable loss of land. From a mitigation perspective, there are more pragmatic options available for addressing coastal storm inundation than there are for coastal erosion.

It could be argued that both scenarios I am recommending are not high hazard areas at the present day. However, the areas mapped as being affected by a 1% AEP coastal storm with an additional 1.2m of sea level rise, and a likely future shoreline position in 2120 with the influence of an additional 1.2m of sea level, could be a high hazard area by the end of a 100-year planning timeframe. This is the timeframe to consider as required by the NZCPS and CRPS and recommended by the MfE Guidance.

However, incorporating these areas as high coastal hazard in the draft district planning maps for initial consultation and comment would be useful. They realistically project the potential high hazard areas within a 100-year planning timeframe and allow a good starting point for gathering feedback from property owners within these potentially exposed areas on their appetite and thresholds for coastal hazard risk, and for testing potential coastal hazard mitigation options/provisions on occupiers with a variety of land uses.

High coastal hazard areas could be reassessed following the initial consultation/engagement period on the draft plan and planning maps and refined through some further thinking around the differential risk presented to different areas and land uses identified as being exposed to coastal erosion hazards and storm inundation hazards. I would note however, that there is not actually a great deal of difference between the modelled 1% AEP coastal storm event coupled with the higher sea level rise scenarios i.e. 0.6 to 1.5m of SLR, along much of the Timaru coastline, especially in locations where there is already existing development.

6. Summary of recommendations

Based on the information and scenarios presented in the Timaru coastal hazard assessment reports, for the high coastal hazard area mapping to be used in the draft planning maps I recommend;

- For high coastal erosion hazard: the 1.2 metre sea level rise scenario 2120 P50 (most likely) future shoreline position, and;
- For high coastal inundation hazard: the 1% AEP coastal storm inundation extent combined with the 1.2m sea level rise scenario.

7. References

Canterbury Regional Council. 2020 (republished). Canterbury Regional Policy Statement. 328pp.

Department of Conservation. 2010. New Zealand Coastal Policy Statement. 28pp.

Department of Conservation. 2017. NZCPS 2010 guidance note: Coastal Hazards Objective 5 and Policies 24, 25, 26 and 27. 100pp.

Ministry for the Environment, 2017. Coastal hazards and climate change: guidance for local government. Ministry for the Environment publication ME1341.