MfE Coastal Hazards and Climate Change Guidance Report

Bay of Plenty Regional Council
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Executive summary

The purpose of this report is to set out the Bay of Plenty Regional Council – Toi Moana (BOPRC) position on future temperature and sea-level rise (SLR) projections for the region.

The report:

- Resolves the current differences between the Regional Policy Statement (RPS), the more recent (2017) national Ministry for the Environment (MfE) Guidance for local government on coastal hazards and climate change, and the projections from the Tauranga Harbour Extreme Sea Level Analysis report.
- Makes a recommendation on future temperature increases for the use of rainfall generation via High Intensity Rainfall Design System (HIRDS).

The stated sea-level rise projections are intended for use in all BOPRC regulatory processes and associated engineering and science technical projects.

The Regional Policy Statement policy relating to sea-level rise (NH11B) is based on the 2008 MfE guidance which is now superseded by the MfE Guidance published in 2017. Policy NH 11B includes the statement, *"Authoritative up-to-date projections of changes in sea level … will be used as updated scientific data become available."* This report sets out how the sea-level rise projections detailed in the RPS policy and the projections in the MfE Guidance 2017 are to be interpreted when giving effect to the RPS.

The MfE Guidance (2017) promotes a Dynamic Adaptive Pathway Planning (DAPP) approach. In the interim, until the DAPP approach has been implemented, the Guidance provides New Zealand-wide sea-level rise projections based on four Representative Concentration Pathway (RCP) scenarios. Bay of Plenty Regional Council commissioned NIWA to express these projections relative to the Moturiki datum, MVD-53, used in the Bay of Plenty region. Together, the MfE Guidance 2017 and these regional sea-level rise projections are considered to be "authoritative up-to-date" information for RPS purposes. Therefore, they need to be interpreted within the RPS policy framework and that is the purpose of this report. The outcome of this interpretation should be used for all regulatory processes.

The MfE Guidance recommends using transitional sea-level rise values with the main aim to progress towards using the DAPP approach in the future. Bay of Plenty Regional Council has adopted a set of transitional values based on the MfE Guidance 2017, the Bay of Plenty regional NIWA report and the RPS requirements, as set out in Table 1 below.

Table 1 Summary table of transitional sea level rise projection values for Bay of Plenty Regional Council.

BOPRC category	BOPRC description	SLR scenario	SLR projection 2130, MVD-53	Temperature projection 2130 (for HIRDS)
A	Coastal subdivision, greenfield developments and major new infrastructure. Changes in land use.	RCP 8.5H+, median value or DAPP.	1.59 m or use all four SLR scenarios.	3.68°C
B	Redevelopment (intensification) and existing coastal development.	RCP 8.5 median value or DAPP.	1.25 m or use all four SLR scenarios.	3.68°C
C	Relocatable activities/developments.	RPS Policy NH 11B (b) or DAPP.	0.85 m or use all four SLR scenarios.	1.67°C

Contents

Part 1:
Introduction

Purpose

The purpose of this report is to set out the Bay of Plenty Regional Council – Toi Moana (BOPRC) position on future sea-level rise projections and temperature change (for rainfall generation) for the region. The report resolves the current differences between the Regional Policy Statement (RPS) and the more recent (2017) national MfE Guidance on coastal hazards and climate change. The stated sea-level rise projections are intended for use in all BOPRC statutory processes and associated engineering and science technical projects.

Background

The MfE Guidance for local government on coastal hazards and climate change (The MfE Guidance) was released in December 2017. The MfE Guidance is based on the findings of sea-level rise and air temperature projections of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment.

The MfE Guidance supersedes the previous coastal hazards and climate change guidance published by MfE in 2008. The RPS climate change policy relating to sea-level rise (Policy NH 11B) is based on the projections provided in the 2008 MfE Guidance.

Bay of Plenty Regional Council commissioned NIWA to express the national sea-level rise projections given in The MfE Guidance relative to the Moturiki datum, MVD-53, for the Bay of Plenty region (NIWA, 2017). These sea-level rise projections are considered to be "authoritative up-to-date" information.

Also in December 2017, the Department of Conservation (DOC) released guidance on the New Zealand Coastal Policy Statement 2010 (NZCPS) coastal hazard objectives and policies, to support The MfE Guidance. The DOC guidance was considered when assessing the implications of adopting The MfE Guidance on sea-level rise projections.

Vertical datum

All vertical levels in this report are in relation to Moturiki Vertical Datum 1953 (MVD–53) including all sea-level rise levels that are relative to MVD–53. The relationships between MVD–53 and the 1980–1999 baseline (referenced in the RPS) and the 1986–2005 baseline (referenced in the MfE Guidance) are shown in Figure 6 of the RPS Natural Hazard Risk Assessment User Guide.

Consideration is being given to shifting from MVD-53 to the New Zealand Vertical Datum 2016 (NZVD2016); the timing of this has not been decided to date.

Part 2:
Comparision of the MfE Guidance and the RPS

The MfE Guidance

The MfE Guidance provides a set of four future sea-level rise projections to the year 2150 based on the Representative Concentration Pathway (RCP) scenarios given in the IPCC Fifth Assessment (Figure 1):

- RCP8.5 H+ (83rd percentile)
- RCP8.5 median
- RCP4.5 median
- RCP2.6 median.

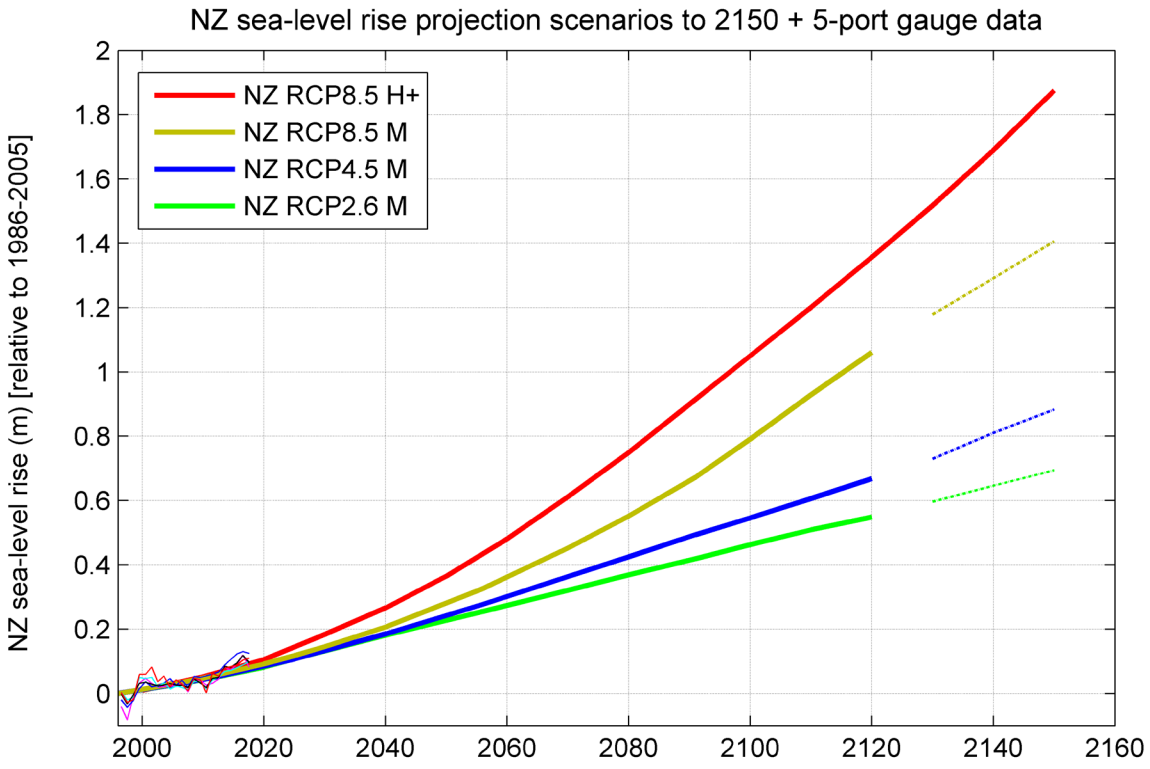

Figure 1 *The four sea-level rise projections given in the MfE Guidance showing the historical New Zealand sea level from five gauge records (four main ports and Moturiki — cyan coloured).*

These New Zealand wide sea-level rise projections were based on the global projections with an increment offset of 0.05 m applying to the south-west Pacific Ocean. The New Zealand projections, relative to the 1986–2005 mean sea level, have been adjusted to the Moturiki datum, MVD-53, by the addition of 0.07 m, the difference between the 1986–2005 baseline and MVD-53, to produce the Bay of Plenty region sea-level rise projection relative to MVD-53 (NIWA, 2017). The regional sea-level rise projections are provided in Table 2 below, at year 2070 and year 2130 timeframe. The sea-level rise projections in Table 2 apply to Tauranga and surrounds, and could differ over the wider Bay of Plenty region due to regional differences in mean sea level and vertical land motion. The current (as at 2019) 2130 planning timeframe is considered appropriate for statutory purposes, giving effect to both the NZCPS and the Bay of Plenty Regional Coastal Environment Plan requirements to plan for at least 100 years, including a 10 year life-of-a-plan period.

Table 2 SLR projection (metres above MVD-53) in 2070 and 2130 for the Bay of Plenty region (Table 6.2 in NIWA 2017).

Year	NZ RCP2.6 *M* (median)	NZ RCP4.5 *M* (median)	NZ RCP8.5 *M* (median)	NZ *H*+
1986–2005	0.07	0.07	0.07	0.07
2070	0.39	0.43	0.52	0.68
2130	0.67	0.81	1.25	1.59

The MfE Guidance recommends using a dynamic adaptive path planning (DAPP) approach for long-term coastal hazard management using all four sea-level rise projection scenarios. The MfE Guidance also provides transitional values for use until a DAPP process has been implemented. Transitional values are likely to be widely used by BOPRC because many statutory decisions and associated technical projects require a specific sea-level rise component to account for future climate change impacts.

The MfE Guidance lists four activity categories with distinct transitional sea-level rise allowances:

1 ***Category A*** *— Coastal subdivision, new and greenfield developments, major new infrastructure — SLR allowance 8.5H+ scenario stems from the expected long life of such new developments coupled with the requirement in the NZCPS 2010 to avoid future hazard risk over the timeframes beyond 100 years.*

2 *For informing where intensification of existing development is inadvisable (**Category B**), no transitional SLR value is provided — rather the full dynamic adaptive pathways planning approach should be undertaken using all four SLR scenarios (at the scale appropriate to the proposed intensification), before further intensification occurs (to avoid compounding the future risk).*

3 ***Category C*** *generally covers existing development (and is the most challenging for adaptation).*

4 ***Category D*** *applies to short-lived non-habitable assets with a functional need to be at the coast, and either consequences are low or readily adaptable (including services).*

The MfE Guidance lists New Zealand wide minimum sea-level rise values for use in development and infrastructure planning (Table 3). These transitional values are recommended where a single value is required at local/district scale while in transition towards DAPP using all four sea-level rise scenarios.

Table 3 The MfE Guidance minimum transitional values (Table 12 in the MfE Guidance) relative to the 1986-2005 mean sea level.

Category	Description	Transitional response
A	Coastal subdividion, greenfield developments and major new infrastructure	Avoid hazard risk by using sea-level rise over more than 100 years and the H+ scenario
B	Changes in land use and redevelopment (intensification)	Adapt to hazards by conducting a risk assessment using the range of scenarios and using the pathways approach
C	Land-use planning controls for existing coastal development and assets planning. Use of single values at local/district scale transitional until dynamic adaptive pathways planning is undertaken	1.0 m SLR
D	Non-habitable short-lived assets with a functional need to be at the coast, and either low-consequences or readily adaptable (including services)	0.65 m SLR

The description in Table 3 can be interpreted in different ways and the transitional values have no scenario reference or timeframe. Bay of Plenty Regional Council sought clarification from MfE on these issues. Ministry for the Environment confirmed that the sea-level rise values are relative to the 1986–2005 mean sea level. From Table 10 of The MfE Guidance, the 1.0 m sea-level rise value for existing coastal development (Category C) is based on the RCP8.5 median scenario to the year 2115; the 0.65 m sea-level rise value for non-habitable assets is based on the RCP4.5 median scenario to the year 2115.

RPS sea-level rise policy

The RPS policy relating to sea-level rise is contained in Policy NH 11B — Providing for climate change and is set out below.

Incorporate the effects of climate change in natural hazard risk assessment. Authoritative up-to-date projections of changes in sea level, rainfall, temperature, and storm frequency and severity will be used as updated scientific data become available.

Use the following projections as minimum values when undertaking coastal hazard assessments:

(a) A 100-year period

[A 2130 planning timeframe is considered appropriate for city and district plan purposes.]

(b) A projection of a base sea-level rise of at least 0.6 m (above the 1980–1999 average) for activities/developments, which are relocatable.

(c) A projection of a base sea-level rise of 0.9 m (above 1980–1999 average) for activities where future adaptation options are limited, such as regionally significant infrastructure and developments which cannot be relocated.

(d) An additional sea-level rise of 10 mm/annum for activities with life spans beyond 2112.

There are differences in the activity categories provided in the RPS policy above and the transitional value categories provided in The MfE Guidance. The MfE Guidance lists four categories (Table 3), while the RPS includes only two categories (i.e. relocatable and non-relocatable).

We note the RPS sea-level rise policy is based on the 2008 MfE guidance, which is now superseded. While the projections given in Part (b), (c) and (d) of NH 11B require updating based on authoritative up-to-date projections, they remain as minimum values that should be replaced only by higher up-to-date projections of sea-level rise.

Part 3:
Adopted sea-level rise values

Activity categories and transitional values

The MfE Guidance recommends using transitional sea-level rise values while working towards using the Dynamic Adaptive Pathway Planning approach in the long-term.

Bay of Plenty of Regional Council has developed a set of transitional sea-level rise projection values based on The MfE Guidance and the requirements of the RPS. The Appendix presents a detailed table of the decision matrix including the RPS and The MfE Guidance requirements. The Bay of Plenty Regional Council transitional values are set out in Table 4 below which includes three categories, the appropriate RCP scenario and the corresponding sea-level rise projection at the year 2130.

Table 4 Summary table of minimum transitional sea-level rise projection values for BOPRC.

BOPRC category	BOPRC description	SLR scenario	SLR projection 2130, MVD-53
A	Coastal subdivision, greenfield developments and major new infrastructure. Changes in land use.	RCP 8.5H+, median value or DAPP.	1.59 m or use all four SLR scenarios.
B	Redevelopment (intensification) and existing coastal development.	RCP 8.5 median value or DAPP.	1.25 m or use all four SLR scenarios.
C	Relocatable activities/developments.	RPS Policy NH 11B (b) or DAPP.	0.85 m or use all four SLR scenarios.

Bay of Plenty Regional Council adopted the first three categories (A, B, C) as recommended by the MfE Guidance with one exception. The one exception to The MfE Guidance description is that the "changes in land use" activity is moved from category B to A. This change was deemed necessary because a change in land use is a requirement for Greenfield development and coastal subdivision (Category A), but not redevelopment or intensification (Category B).

Also, the MfE Guidance does not provide a sea-level rise value for its Category B, Redevelopment (intensification). Instead, it requires the use of DAPP with all four scenarios. As shown in the Appendix, the default value in this case is the RPS minimum value or 1.15 m (MVD, 2130). However, for consistency with Category C, which relates to existing coastal development, BOPRC has chosen to adopt the RCP 8.5 median value, 1.25 m (MVD, 2130). These two categories were joined and named BOPRC Category B.

The MfE Guidance activity Category D has been simplified to define all activities and developments that are **relocatable** to align with the description given in the RPS and is now Category C.

Additional "authoritative up-to-date projections of changes in sea level" have been provided by NIWA, (2017). Therefore, these projections are used for the specific RCP scenarios and timeframes required. The current (as at 2019) 2130 planning timeframe is considered appropriate for statutory purposes giving effect to both the NZCPS and the Bay of Plenty Regional Coastal Environment Plan requirements to plan for at least 100 years, including a 10 year life-of-a-plan period.

Sea-level rise uncertainty

There is no way of predicting with certainty what the future may bring in regards to climate change. The future rate and magnitude of sea-level rise is unknown and is strongly dependent on Government policy and human behaviour. Therefore, there is deep uncertainty in sea-level rise projections for timeframes extending beyond 2100 and likelihoods or best estimates cannot be predetermined. Sea-level rise decisions must therefore, be based on scenarios to assess a range of possible futures that could eventuate. Our recommendations provide transitional values based on selected scenarios where an absolute value is required for some Council decisions (i.e. building floor height). We also recommend revising this memo based on any new national scientific information provided by Central Government agencies.

Part 4:
Temperature rise values

Climate change response

It is generally accepted that with climate change, the extreme precipitation will increase in intensity. This general increase is due to the Clausius-Clapeyron (C-C) relation, which states that the amount of precipitable water the atmosphere can hold increases by approximately 7% per degree of warming. However, increasingly, research has shown that there are additional processes impacting on precipitation extremes that also need to be taken into account. These include changes in dynamic processes such as vertical velocity [Pfahl et al., 2017] which can lead to the intensification of short duration convective storms [Feng et al., 2016; Prein et al., 2017].(HIRDS v4 Technical report, 2018).

The impact of climate change on extreme precipitation was assessed using Regional Climate Model (RCM) simulations over New Zealand spanning from 1971-2100. For each RCM simulation, hourly estimates of precipitation were used to calculate annual maxima series for all standard durations (1 hour through 5 day) at each model grid square. The generalised extreme value (GEV) distribution was then fitted to the annual maxima series at each grid square separately. (Source NIWA HIRDS4).

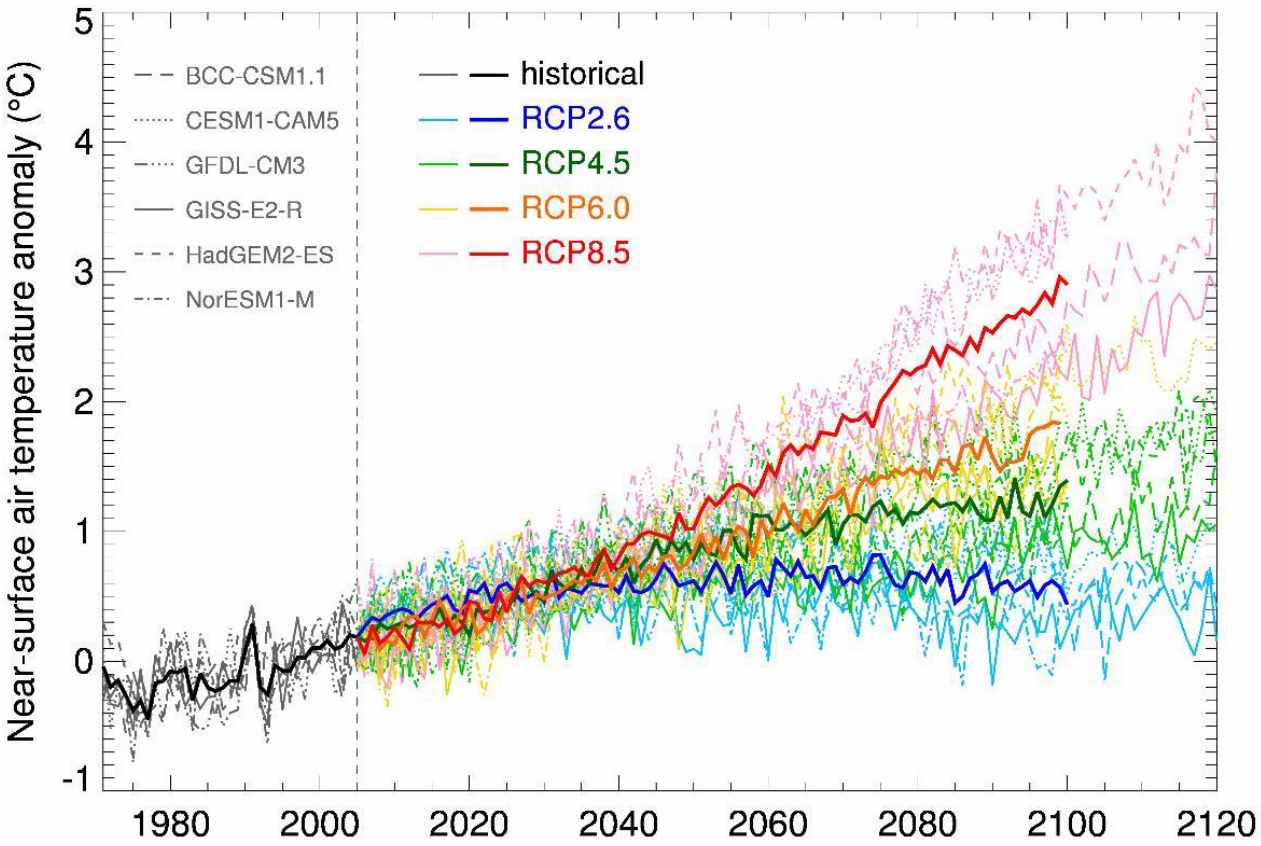

Figure 2 *Projected New Zealand-average temperatures relative to 1986-2005 for six CMIP5 global climate models downscaled via NIWA's RCM. Historical simulations (here 1971-2005) and four future simulations (RCPs 2.6, 4.5, 6.0 and 8.5) are included [Mullan et al., 2016]. (HIRDSv4 report).*

Temperature extrapolation to 2130

The current 2130 planning timeframe is considered appropriate for statutory purposes; therefore extrapolation is needed beyond 2100. In this assessment, a simple linear extrapolation was used where the exact slopes are calculated from previous two points. While it is recognised that linear extrapolation assumes that the temperature is increasing at a linear rate going into the future, it is not critical due to the short extrapolation period, between 2100 and 2130.

Table 5 Slope based extrapolation on all four available temperature change estimates. The slopes come to 0.000, 0.010, 0.023 and 0.033°C/year for each of the four RCPs respectively.

Date Range	2031 - 2050	2056-2075	2081 - 2100	2101 - 2120	2111-2130 (Extrapolated)	2121 - 2140 (Extrapolated)
	2040	2065	2090	2110	2120	2130
RCP 2.6	0.59	0.67	0.59	0.59	0.59	0.59
RCP 4.5	0.74	1.05	1.21	1.44	1.555	1.67
RCP 6.0	0.68	1.16	1.63	2.31	2.65	2.99
RCP 8.5	0.85	1.65	2.58	3.13	3.405	3.68

Pairing rainfall scenarios with SLR scenarios

The MfE (2017) guidance focuses not on specific RCP and SLR scenarios, but on considering a range of scenarios with the allowance of uncertainty. Table 6 below pairs rainfall scenarios with SLR scenarios to the year 2130 to meet the requirements of the New Zealand Coastal Policy Statement (NZCPS). Table 6 below follows the minimum transitional SLR scenarios for four categories and makes pairings of SLR scenario with temperature increase scenarios while considering the climate-change scenarios on which each is based (Category A, B and C) or close to (Category D).

Table 6 Sea-level rise and temperature projections to 2130.

BOPRC category	BOPRC description	SLR scenario	SLR projection 2130, MVD-53	Temperature projection 2130 (for HIRDS)
A	Coastal subdivision, greenfield developments and major new infrastructure. Changes in land use.	RCP 8.5H+, median value or DAPP.	1.59 m or use all four SLR scenarios.	3.68°C
B	Redevelopment (intensification) and existing coastal development.	RCP 8.5 median value or DAPP.	1.25 m or use all four SLR scenarios.	3.68°C
C	Relocatable activities/developments.	RPS Policy NH 11B (b) or DAPP.	0.85 m or use all four SLR scenarios.	1.67°C

Part 5:
References

Ministry for the Environment 2008. Coastal Hazards and Climate Change. A Guidance Manual for Local Government in New Zealand. 2nd edition. Revised by Ramsay, D, and Bell, R. (NIWA). Prepared for Ministry for the Environment. Viii+127p.

Ministry for the Environment 2017. Coastal Hazards and Climate Change: Guidance for local government. Ministry for the Environment Publication. Wellington, Ministry for the Environment.

NIWA 2017. Tauranga Harbour extreme sea level analysis. Prepared for Bay of Plenty Regional Council.

NIWA: 2018 High Intensity Rainfall Design System. Version 4 Prepared for Envirolink.

Appendices

Appendix 1:

Sea-level rise decision matrix

This table compares the different approaches taken by the Bay of Plenty Regional Policy Statement and the Coastal Hazards and climate change: Guidance for local government 2017 and presents "Resolutions" that satisfy both approaches until Dynamic Adaptive Pathway Planning is implemented.

RPS - >			Decision	< - Guidance		
Policy	**Description**	**Minimum SLR value**	**Minimum SLR value**	**Minimum SLR value**	**Description**	**Category**
NH 11B (b) **OR** NH 11B (c)	"relocatable" **OR** "future adaptation options are limited, such as regionally significant infrastructure and development which cannot be relocated"	"0.6 m" (1980–1999, 2112) = 0.85 m (Moturiki[1], 2130)[2] **OR** "0.92 m" (1980–1999, 2112) = 1.15 m (Moturiki, 2130)[3]	**"relocatable"- Use 0.85 m (RPS)** **OR** **"non-relocatable"** Decide between 1.15 m and H^+: **Resolution: Use H^+ (Guidance): 1.59 m (Moturiki, 2130)**	"H^+" = 1.59 m (Moturiki, 2130)	New developments. Greenfields. Major new infrastructure.	A
			"relocatable"- Use 0.85 m (RPS) **OR** **"non-relocatable"** **Resolution: Use both: 1.15 m minimum and analyse range of scenarios and take an adaptive approach**	"Use range of scenarios and adaptive approach"	Intensification of existing development.	B
			"relocatable"- Use 0.85 m (RPS) **OR** **"non-relocatable"** Decide between 1.15 m and RCP8.5 median **Resolution: use RCP8.5 median: 1.25 m (Moturiki, 2130)**	"1.0 m"(1986–2005)[4] a "single value" that equates to RCP8.5 median to 2115[5] = 1.25 m (Moturiki, 2130)	Existing development.	C
			Do not use this category Follow the RPS policy approach of distinguishing in all categories on the basis of being able to be relocated.	"0.65 m" (1986–2005, aligns with RCP 4.5 median to 2120: 0.67 m in the MfE Guidance (2017) Table 10) = 0.81 m (Moturiki, 2130).	Short-lived, non-habitable assets and low consequences readily adaptable.	D

[1] Moturiki Vertical Datum 1953 (MVD–53): This provides a common datum for referencing Bay of Plenty sea-level rise values rather than the averages in the guidance that change with each generation of guidance. Consideration is being given to shifting from MVD-53 to the New Zealand Vertical Datum 2016 (NZVD2016); this is not decided.

[2] Starting from the 2007 base sea-level rise to 2100 of 0.5 m, extend to 2112 (additional sea-level rise of 10 mm/annum for activities with life spans beyond 2100: 12 years (2100 to 2112) = 0.62 m (rounded to 0.6 m in RPS Policy NH 11B (b)) + 0.053 m (the sea-level rise between MVD–53 and the 1980–1999 average) + 0.18 m (additional sea-level rise of 10 mm/annum for activities with life spans beyond 2112: 18 years (2112 to 2130)) = 0.85 m.

[3] Starting from the 2007 sea-level rise to 2100 of 0.8 m, extend to 2112 (additional sea-level rise of 10 mm/annum for activities with life spans beyond 2100: 12 years (2100 to 2112) = 0.92 m (rounded to 0.9 m in RPS Policy NH 11B (c)) + 0.053 m (the sea-level rise between MVD–53 and the 1980–1999 average) + 0.18 m (additional sea-level rise of 10 mm/annum for activities with life spans beyond 2112: 18 years (2112 to 2130)) = 1.15 m.

[4] Pers. Comm. Email from MfE Thu 17/01/2019 1:20 p.m. with Rob Bell's explanation that 1 m is approximately the RCP8.5 median for the wider New Zealand region.

[5] Ministry for the Environment 2017. Coastal Hazards and climate change: Guidance for local government, page 108 Table 12 and narrative. Publication number: ME 1341. MfE, Wellington. 279 pp.