3. Pre-calculated extreme water levels

3.1 Introduction

For many development planning decisions, for example consideration of minimum ground and floor levels for safe building development, a knowledge of high tide and extreme water levels is important.

Rather than having to use the calculator to derive this information the following tables and figures provide pre-calculated values of high tide and extreme water levels for:

- The lagoon and ocean shorelines of Tarawa.
- The three I-Kiribati climate change scenarios (B2, A2, A1FI).
- The present day and three I-Kiribati future timeframes (Grand children / Te tibu, Great-grand children / Tibu-toru, great-great-grand children / Tibu-mwamwanu).

For consideration of different timeframes or climate change scenarios, or for assessment of local inundation potential immediately behind the shoreline where wave run-up and overtopping may be a factor, the calculator will still need to be applied using appropriate parameters for the local reef and shoreline characteristics.

The following pre-calculated water levels and joint probabilities are presented:

MLOS — Mean Level of the Sea (1980-1999 average for present day).

MHWS — Mean High Water Spring Level (1980-1999 average for the present day).

MHWPS — Mean High Water Perigean Spring Level (1980-1999 average for the present day).

10% AEP — 10% chance of a particular offshore wave / water level combination occurring in any one year (10 year return period).

2% AEP — 2% chance of a particular offshore wave / water level combination occurring in any one year (50 year return period).

1% AEP — 1% chance of a particular offshore wave / water level combination occurring in any one year (100 year return period).

Appendix 1 shows how these water levels relate to each other for the present day.

The following table provides a guide to locate the sea-level information within the following tables and figures.

Table 3: Summary of tide, storm tide and wave set-up level plots.

Location / water level information	Timeframe	Figure	Location
Tide levels (MLOS,MHWS, MHWPS)	Te tibu (2012-2036) Tibu-toru (2036-2060) Tibu- mwamwanu (2060-2074)	6	Top Centre Bottom
Lagoon shoreline 10%, 2% & 1% AEP storm tide levels	Te tibu (2012-2036) Tibu-toru (2036-2060) Tibu- mwamwanu (2060-2074)	7	Top Centre Bottom
Tarawa ocean shore (south) 10%, 2% & 1% AEP wave set-up levels	Te tibu (2012-2036) Tibu-toru (2036-2060) Tibu- mwamwanu (2060-2074)	8	Top Centre Bottom
Tarawa ocean shore (north (east)) 10%, 2% & 1% AEP wave set-up levels	Te tibu (2012-2036) Tibu-toru (2036-2060) Tibu- mwamwanu (2060-2074)	9	Top Centre Bottom

3.1.1 Lagoon shoreline extreme water levels overview

Tide and extreme water levels vary slightly (by a few cm's) around the shoreline of Tarawa lagoon due to slight changes in tide range and storm-surge characteristics. 10%, 2% and 1% AEP storm tide water levels (tide + storm surge) were derived at 23 locations around the Tarawa lagoon shoreline (see Appendix 1) and can be accessed directly in the Coastal Calculator.

Given the relatively minor variability in levels, and the accuracy of topography levels in Tarawa, the 10%, 2% and 1% AEP storm tide levels presented in Figure 6 can be used in most situations.

3.1.2 Ocean shoreline extreme water levels overview

Extreme water levels along the ocean shoreline of Tarawa are a combination of tide level, storm surge and wave set-up. Wave set-up levels vary depending on the characteristics of the fringing reef and reef flat. For the purposes of the water levels presented in Figures 7 to 8, the following has been assumed:

- The reef flat level is assumed to be 0.8 m relative to University of Hawaii Gauge Datum.

- Solomon, (1997) suggested that reef flat levels varied between 0.6 – 1.0 m relative to University of Hawaii Gauge Datum. This range results in a variation in extreme water level of up to about ±0.07 m.

- A reef edge slope of 1:3 is assumed. A steeper reef edge slope will give larger wave set-up values. Depending on the wave height and water level this may vary wave set-up levels by up to a few 10's of cm's.

- Waves breaking is assumed to occur on the reef edge and rim.

- Reef width does not influence wave set-up on either the south or north (east) Tarawa coast.

3.2 Tide levels

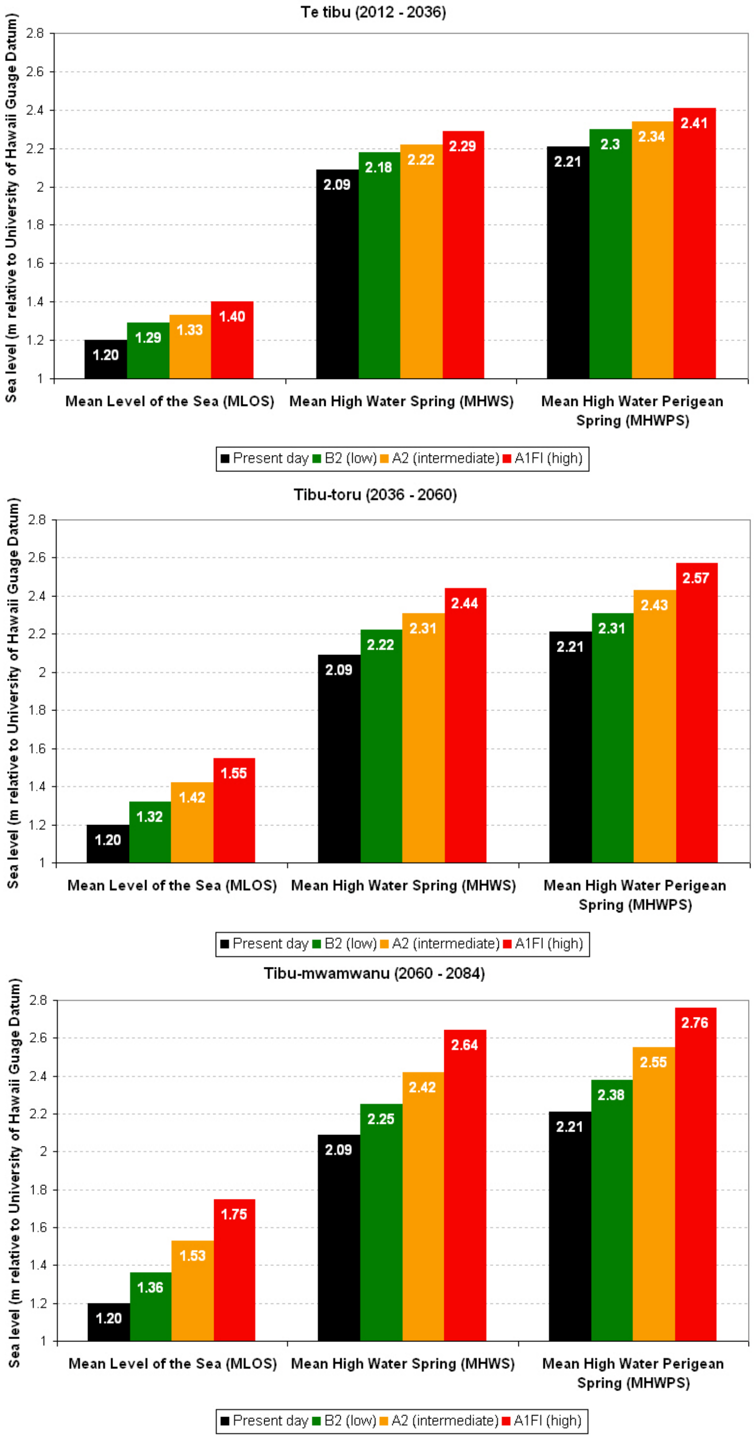

Figure 6: **Tide levels:** Mean level of the sea and high tide for the present day (1980-1999 average) and three I-Kiribati climate change scenarios (B2 – green, A2 – orange, A1FI - red) and timeframes (Te tibu – top, Tibu-toru – middle, Tibu-mwamwanu – bottom).

3.3 Tarawa lagoon shoreline: Extreme water levels (storm side)

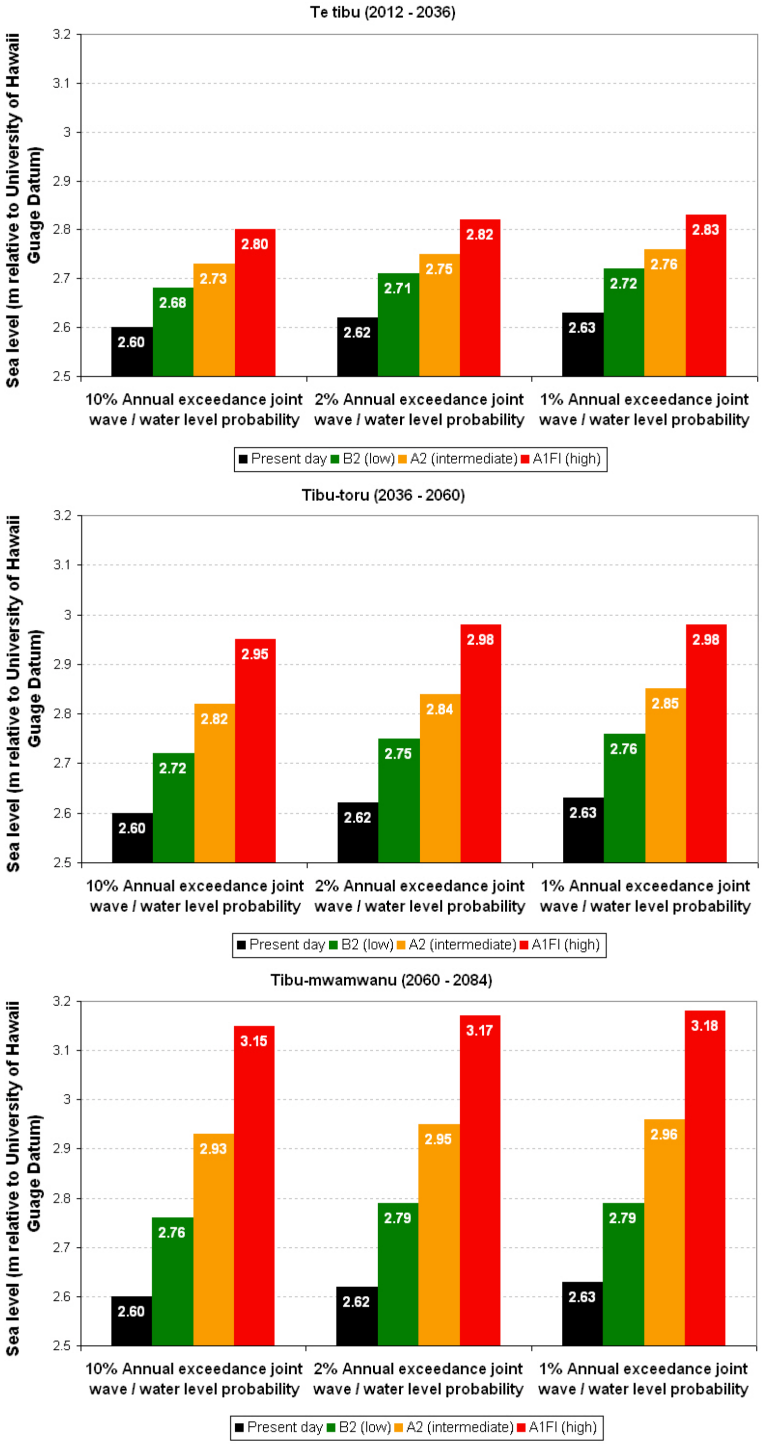

Figure 7: **Tarawa lagoon storm tide levels:** 10%, 2% and 1% AEP storm tide levels for the present day (1980-1999 average) and three I-Kiribati climate change scenarios (B2 – green, A2 – orange, A1FI - red) and timeframes (Te tibu – top, Tibu-toru – middle, Tibu-mwamwanu – bottom).

3.4 Tarawa ocean shore (south): Extreme water levels (storm tide + wave set-up)

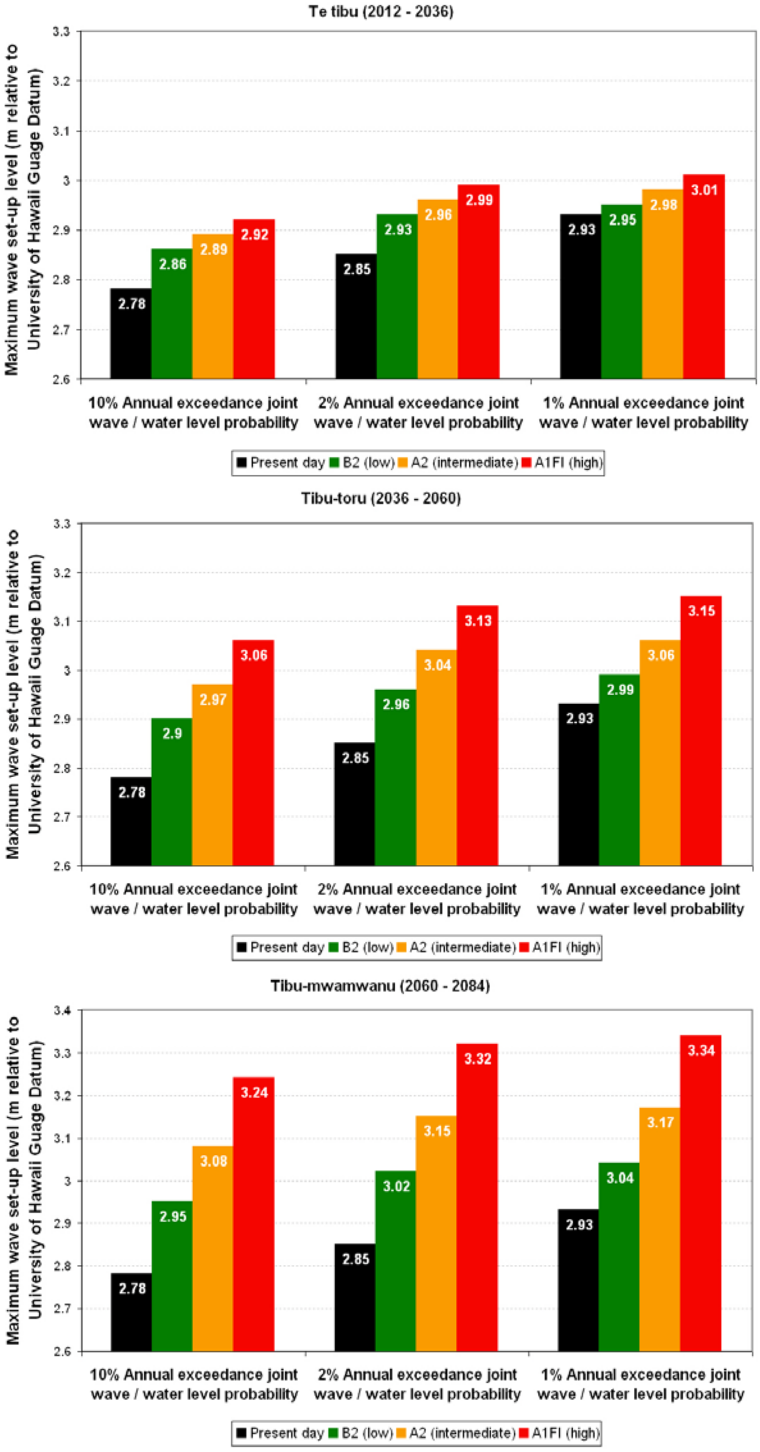

Figure 8: **Tarawa ocean shore (south):** Extreme sea levels (comprising tide, storm surge and wave set-up) corresponding to the wave / water level conditions with a 10%, 2% and 1% chance of occurring in any one year for the present day and three I-Kiribati climate change scenarios and timeframes.

3.5 Tarawa ocean shore (north (east)): Extreme water levels (storm tide + wave set-up)

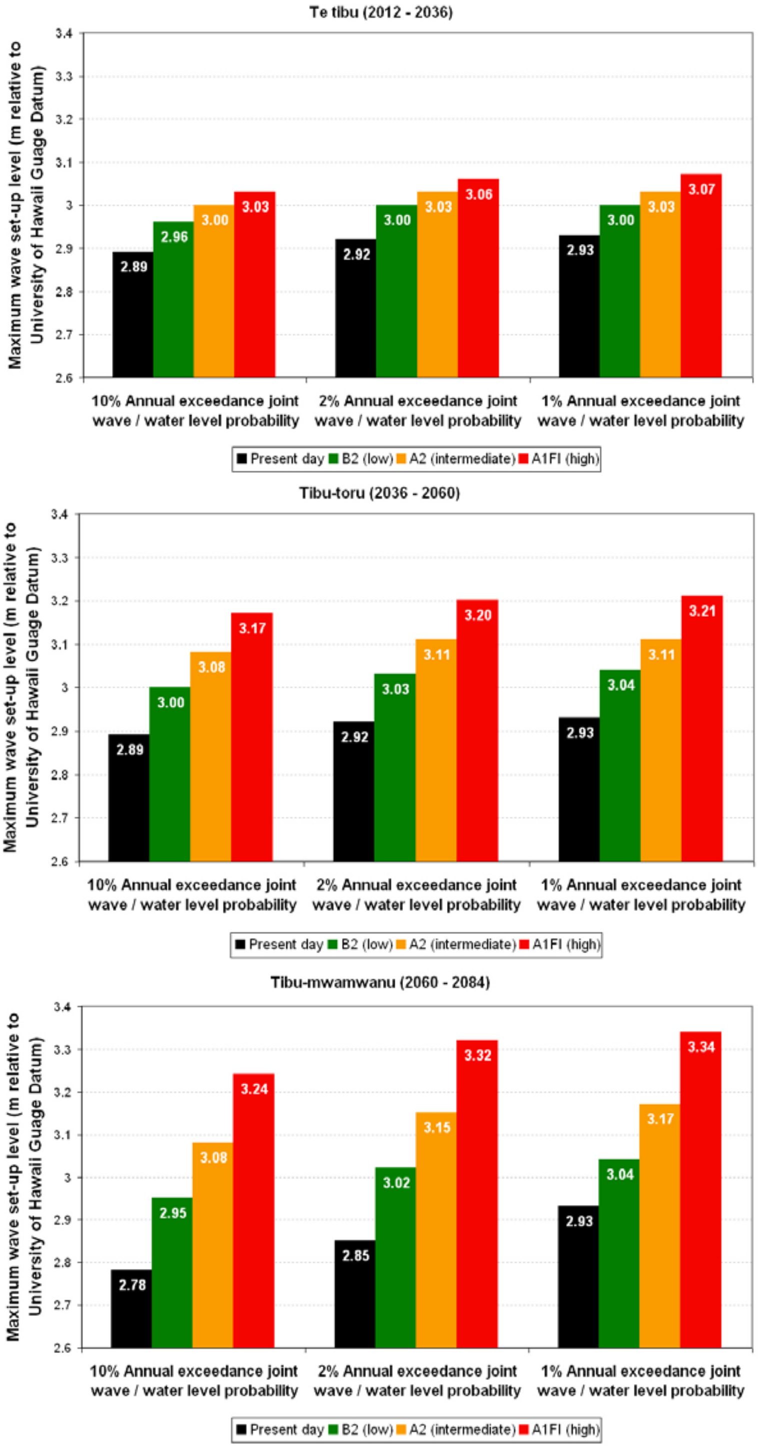

Figure 9: Tarawa ocean shore (north (east)): Extreme sea levels (comprising tide, storm surge and wave set-up) corresponding to the wave / water level conditions with a 10%, 2% and 1% chance of occurring in any one year for the present day and three I-Kiribati climate change scenarios and timeframes. See Section 3.1.2 for particular reef flat characteristics assumed.