32 Mangawhai Heads

32.1 Description and geomorphology

Mangawhai Heads is a peninsula on the north side of Mangawhai Harbour, which is located on the east coast at the southern boundary of the Northland region. Figure 32.1 shows the site and its division into 12 coastal cells for the purpose of assessing coastal erosion hazards. The site is approximately 7 km long and tracks the east coast of Mangawhai Heads harbour and estuary, and extends approximately from the harbour mouth to the Molesworth Drive causeway. The open coast section of Mangawhai is not part of this site assessment. The northern head of the harbour is comprised of a 40 m high hard cliff headland with an underlying dacite geology. As the peninsula extends south, the underlying geology is sedimentary deposits formed from historic sand dune formation in the Pleistocene era. The coastal edge along the site is a mix of hard cliff, sandstone cliff and low-lying estuarine coastal terrace.

Mangawhai Heads is a popular summertime destination close to Auckland and Whangarei, with much of the coast developed with homes, holiday homes and holiday or camping accommodation. From the harbour mouth, the shoreline extends in a general east to west direction for 1 km and is characterised by a mix of hard and soft cliffs, with pockets of small beach area. Upstream of the mouth , the harbour bends 90 degrees and shoreline then trends in a generally north to south direction for approximately 5.2 km before bending around the peninsula tip and back towards the causeway in a north westerly direction for another 2.5 km. The entire coastline of these sections is backed by historic sandstone cliffs, but sections of the coastal edge near streams have built out to form low-lying coastal terraces. An example is the central section where the campground, boat ramp and esplanade reserve are located (Figure 32.2 Cell D). Further south, a similar low-lying sedimentary terrace has been developed with private property at the coastal edge (Figure 32.2 Cells D, G-H).

The south head of Mangawhai Harbour is a vast sand dune system that extends north from Te Arai Beach. Strong onshore winds blow sand from this system into the estuary where it is redistributed by currents and wave action. Cell E has a section of transgressive sand dune wedged against the cliff toe. Sediment supply to the dune at Cell E is likely from wind action on the estuary at low tide, or direct wind transfer from the dunes across the channel. This dune system has accreted seaward in the recent past, however ongoing accretion into the future will possibly be limited because of stronger tidal currents removing sediment as the dune toe moves seaward. A single tidal channel extends from the mouth for 2 km before splitting into two channels with a shallow sand bar in the centre and the main flow on the east side. Wide sand flats and small low tide channels are present at the inner estuary section of the site between the southern point of the peninsula and the causeway.

The first estuarine coastal terrace cell (D) is located along the main holiday park and reserve section where the shoreline turns to face east. Two streams influence coastal morphology at this cell and some sections appear to have been modified with boat ramps, reserve space and discrete protection structures, including a seawall that stabilises the shoreline at the southern section. Similar low-lying coastal terraces are located at Cells G and H, where the coastal edge is defined by private property boundaries and local coastal protection structures including groynes and seawalls. The remaining coastal terrace cells (J and L) are in narrow low-lying sections of coast wedged between wider tidal flats and sedimentary cliff and are developed with properties.

Shoreline sediments along the Mangawhai Heads estuary are characterised by well sorted medium grain sand (D_{50} = 0.25-0.3 mm). This sediment is likely sourced from the Pakiri-Mangawhai coastal compartment and is transferred to the estuary by tidal and aeolian processes.

Depth and fetch for wind wave generation is very limited in Mangawhai Harbour and transmission of ocean wave energy into the mouth is unlikely to be significant due to an offshore ebb tide delta and narrow mouth opening of 100 m. A narrow band of sand beach is present at the base of cliff and terrace sections from Cell A at the mouth to Cell G along the estuary shoreline. Beach sands are not typically present along Cells H-L at the inner estuary.

32.2 Local considerations

A series of storms in the late 1970s and 1980s caused a breach in the south head sand dune barrier that significantly changed hydrodynamic processes in the harbour. As the second passage became wider, flow out of the main passage decreased and it started to fill with sediment and cause navigation hazards. A team of locals worked together to block the breach and clear the main channel in February 1991. A second breach required additional restoration work over the following five years to maintain a stable single harbour channel.

A significant portion of the cliff and low-lying estuary coast is developed and is private property. Mangrove removal likely influenced local shoreline morphology and stability in some sections of the inner harbour, especially near the causeway.

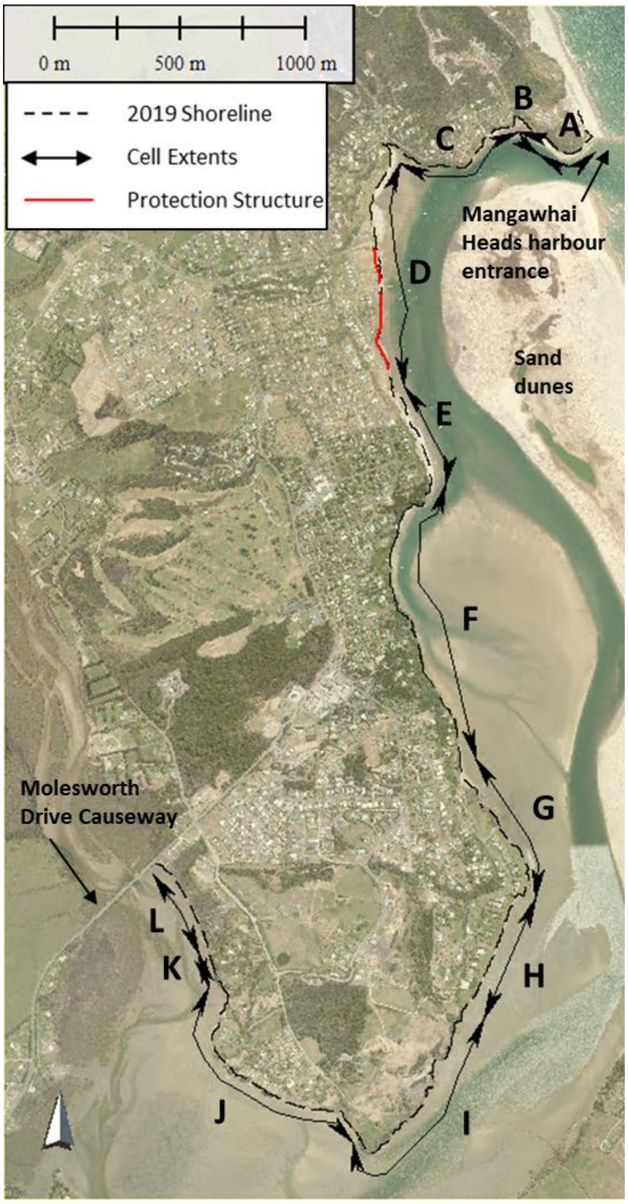


Figure 32.1: Map showing 2019 shoreline position and cell extents with background aerial imagery from 2014.

Figure 32.2: Photos from Mangawhai Heads site visit on 20/01/2020.

32.3 Component values

The site is split into 12 cells to assess coastal erosion hazards based on discrete changes in geomorphology and historic shoreline change. The 12 cells represent four general coastal types and include:

- Five cells backed by soft sedimentary cliff
- One cell backed by hard cliff
- Five cells backed by low-lying coastal terraces
- One coastal terrace with sand dunes

Component values used to calculate coastal erosion hazard zones are presented in Table 32.1 for all cells and future sea level rise scenarios are presented in (Table 32.2). Cell A is located at the mouth of the harbour and has a small intertidal beach backed by 30 m high dacite cliff. The stable angle was assessed by a senior geotechnical engineer to range between 26 and 34 degrees. Cells B and C track along the generally south facing section of the mouth section and are backed by a consolidated shoreline with smalls sections of beach with underlying sedimentary geology. The stable angles for these sandstone cliffs were assessed to range between 18.4 and 26.6 degrees. Similar to B and C, three additional sandstone cliff cells are located towards the inner harbour (F, I and K) for which the same stable angles. Long-term rates at these cliff cells is variable, with a limited long-term rate (i.e. -0.01 m/yr) at the harder cliff on Cell A and a mean long-term rate between -0.02 to -0.12 m/yr for the softer sandstone cliff cells. Erosion of consolidated cliff coasts is a one-way process that is not balanced by accretion. Analysis of historic shoreline change indicates some areas where a slip or landslide resulted in an artificial trend of accretion. Therefore, long-term change results were rationalised to only consider erosion and stability. All cliff cells at Mangawhai Heads were assessed to be responsive to erosion with higher sea level and adopted m-values between 0.3 and 0.5 reflect this.

Coastal terrace cells (Cells D, G, H, J, L) at Mangawhai are considered to be unconsolidated shorelines, based on site observations and underlying geology. Therefore, these cells have a short-term erosion component and a range of slopes for calculating geometric response to sea level rise. These slopes are based on the 'beach face slope' between the tidal flat and edge of vegetation, as assessed using LiDAR, site photos and aerial imagery. The minimum component is based on the lower beach face, the mode component is the total beach face and the maximum component is the upper beach slope. Estuarine beach slopes were assessed at each shoreline terrace cell or adopted from representative adjacent cells.

The same short-term erosion distance was applied to all coastal terrace cells, being representative of east coast estuary environment based on Table 4.6 in the main methodology (T+T, 2020). A long-term rate of historic shoreline change was adopted for each low-lying coastal terrace, based on analysis of how shoreline position has changed over time (Figure 32.3) and interoperation of sediment supply and shoreline dynamics. Adopted long-term rates are typically centred on a mode of 0 to – 0.05 m/yr with an upper bound of +0.05 to +0.1 m/yr. Cell G was historically characterised by a local erosion hotspot and is now stabilised by groynes, has the highest lower bound rate of -0.2 m/yr.

Cell E is unique in that sand dunes have developed in the space between the cliff and high-water mark. Unlike an open coast dune, dynamic cross-shore exchange between the inter-tidal beach and dune is unlikely and any material eroded from the dune will likely be washed alongshore by tidal currents. The adopted long-term rate at this cell was adjusted to reflect that ongoing accretion into the future will likely be hydraulically limited by tidal currents. Therefore, a conservative long-term trend with a mode of 0 m/yr was adopted, with a minimum of -0.1 m/yr and maximum of +0.2 m/yr.

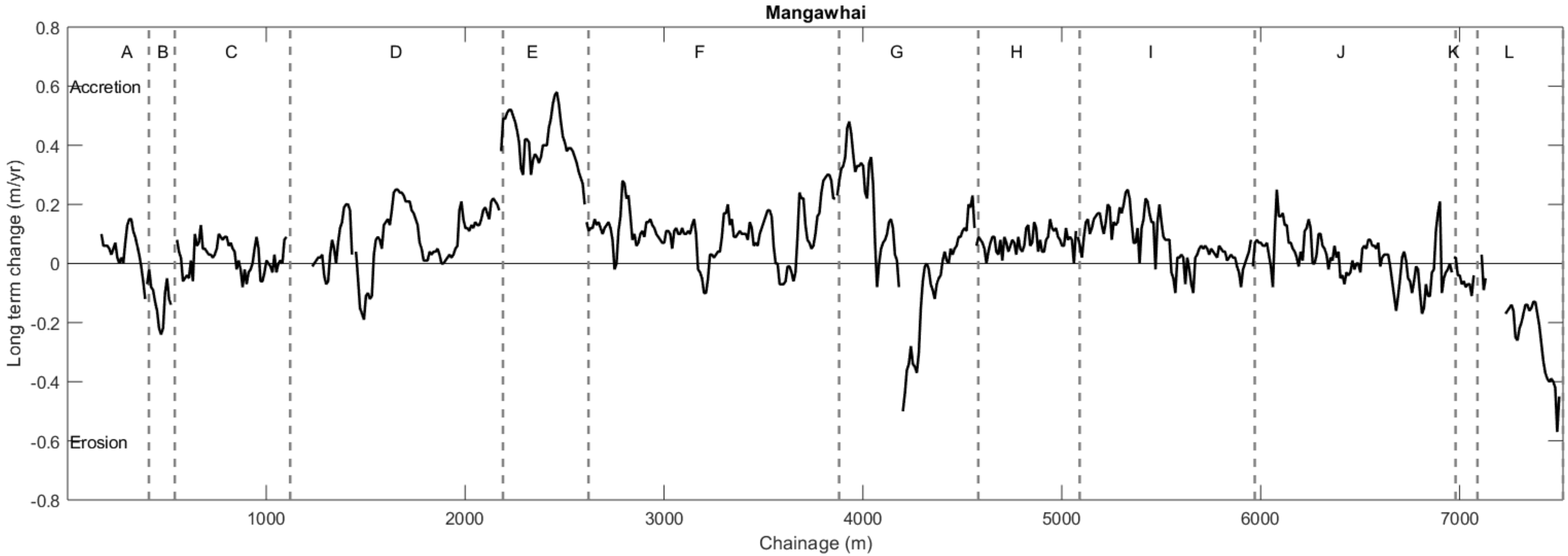


Figure 32.3: Rate of long-term shoreline change along the site showing each cell.

Table 32.1: Component values for Erosion Hazard Assessment

Site		**32. Mangawhai Heads**											
Cell		**32A**	**32B**	**32C**	**32D**[1]	**32E**	**32F**	**32G**	**32H**	**32I**	**32J**	**32K**	**32L**
Cell centre (NZTM)	E	1743892	1743714	1743504	1743201	1743326	1743365	1743683	1743655	1743383	1742640	1742410	1742327
	N	6005682	6005778	6005650	6005279	6004631	6003913	6003068	6002526	6001916	6001974	6002483	6002740
Chainage, m (from E)		1-220	220-380	380-950	950-2000	2000-2440	2440-3700	3700-4400	4400-4900	4900-5780	5780-6800	6800-6900	6900-7330

Site		32. Mangawhai Heads											
Cell		32A	32B	32C	32D[1]	32E	32F	32G	32H	32I	32J	32K	32L
Morphology		Dacite cliff	Partly cemented sand cliff	Partly cemented sand cliff	Estuarine coastal terrace[+]	Estuarine sand dunes	Partly cemented sand cliff	Estuarine coastal terrace	Estuarine coastal terrace	Partly cemented sand cliff	Estuarine coastal terrace	Partly cemented sand cliff	Estuarine coastal terrace
Short-term (m)	Min	-	-	-	2	5	-	2	2	-	2	-	2
	Mode	-	-	-	4	8	-	4	4	-	4	-	4
	Max	-	-	-	6	10	-	6	6	-	6	-	6
Dune/Cliff elevation (m above toe or scarp)	Min	20	0.4	0.2	0.6	3.8	0.5	0.5	0.9	1.2	0.3	0.6	0.3
	Mode	30	2.2	5.4	1.5	5.5	5.9	0.9	1.6	6.8	1.5	1.8	0.8
	Max	40	6.0	13.9	3.0	8.9	18.6	1.5	2.5	14.3	4.7	7.6	2.5
Stable angle (deg)	Min	26.6	18.4	18.4	30	30	30	30	30	18.4	30	18.4	30
	Mode	30	22.5	22.5	32	32	32	32	32	22.5	32	22.5	32
	Max	33.7	26.6	26.6	34	34	34	34	34	26.6	34	26.6	34
Long-term (m/yr) -ve erosion +ve accretion	Min	-0.05	-0.2	-0.05	-0.1	-0.1	-0.1	-0.20	-0.05	-0.05	-0.10	-0.10	-0.10
	Mode	-0.01	-0.12	-0.03	0	0	-0.05	-0.05	0.00	-0.02	0.00	-0.05	-0.05
	Max	0	-0.05	-0.02	0.15	0.2	0	0.05	0.10	0	0.10	0	0
Closure slope (beaches) / Cliff response factor	Min	0.3	0.3	0.3	0.1	0.1	0.3	0.04	0.1	0.3	0.1	0.3	0.0
	Mode	0.4	0.4	0.4	0.11	0.15	0.4	0.06	0.15	0.4	0.16	0.4	0.06
	Max	0.5	0.5	0.5	0.16	0.2	0.5	0.1	0.2	0.5	0.22	0.5	0.11

[1]CEHZ0 method applies to part of cell, [+]Cell partly armoured with engineered coastal protection structure

Table 32.2: Adopted sea level rise values (m) based on four scenarios included in MfE (2017) adjusted to 2019 baseline

Coastal type	Year	RCP2.6M	RCP4.5M	RCP8.5M	RCP8.5+
Consolidated cliff	2080	0.29	0.34	0.46	0.64
	2130	0.52	0.66	1.09	1.41
Unconsolidated beach[1]	2080	0.16	0.21	0.33	0.51
	2130	0.28	0.42	0.85	1.17

[1]Adjusted to remove the influence of historic SLR (2.2 mm/year) on long-term rates of shoreline change

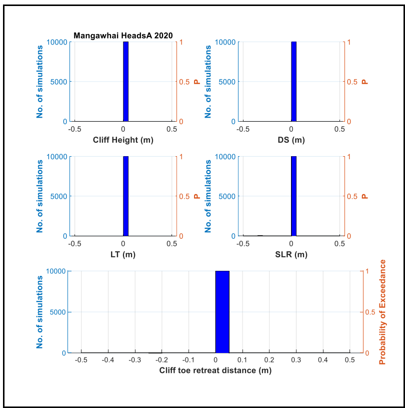
32.4 Coastal erosion hazard assessment

Histograms of individual components and resultant CEHZ distances computed using a Monte Carlo technique are shown in Figure 32.4 to Figure 32.15. Coastal Erosion Hazard Zone widths and future shoreline distances are presented within Table 32.3 to Table 32.5 and mapped in Figure 32.16.

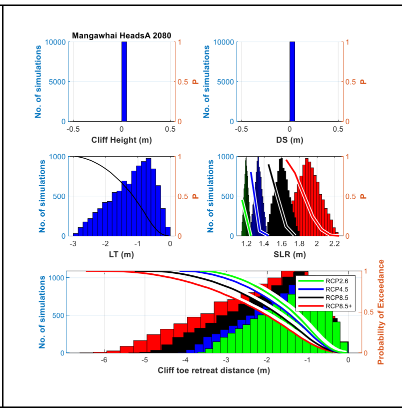
CEHZ1 values range from 10 to 15 m for dune and terrace cells, with Cells G, H and J being rounded up to the minimum value of 10 m for terraces and Cell E being rounded up to the minimum value of 15 m for beach dunes. CEHZ2 values range from 25 to 36 m and CEHZ3 values range from 25 to 42 m, with Cells D, H and J being rounded up to the minimum value of 25 m for terraces and Cell E being rounded up to the minimum value of 35 m for beach dunes.

The cliff projection method was used to identify CEHZ distances for all cliff cells at Mangawhai Heads. The probabilistic CEHZ outputs presented in figures below only shows the cliff toe recession distance for cliff cells. A total CEHZ distance was mapped for cliff cells based on across-shore LiDAR profiles extracted at 10m intervals, where the toe recession and stable angle were used to project the hazard distance. A summary of total hazard distances for cliff cells is presented in Table 32.6. The average CEHZ distance for all cliff cells is 24 m for CEHZ1, 46 m for CEHZ2, and 49 m for CEHZ3. Maximum CEHZ distances are below 60m for CEHZ1 and below 100m for CEHZ3.

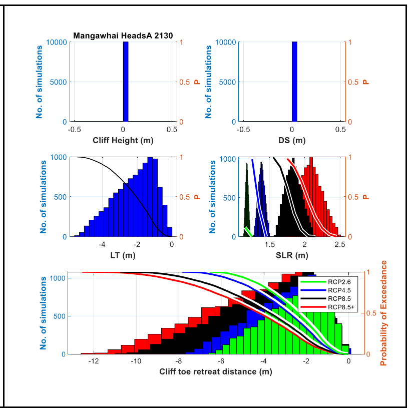
Figure 32.17 shows the available historic shorelines for Mangawhai Heads.



2020

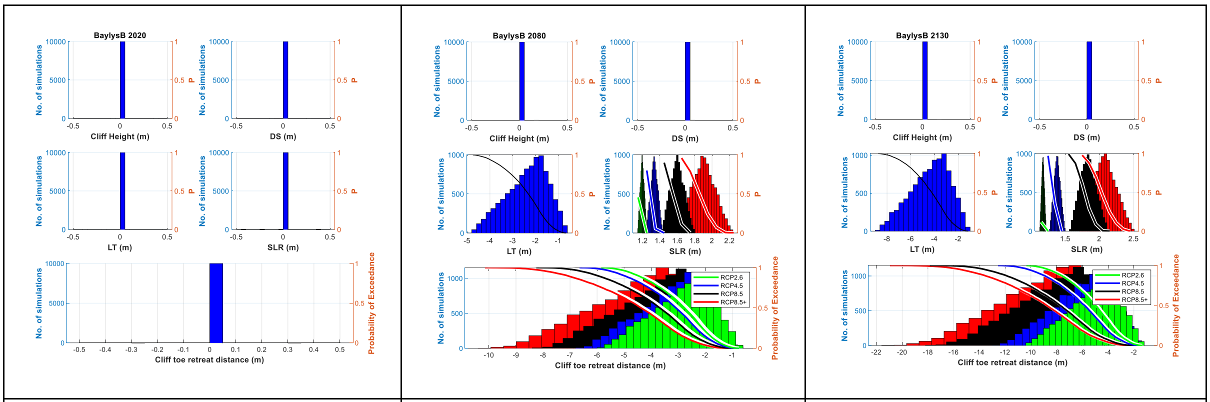


2080



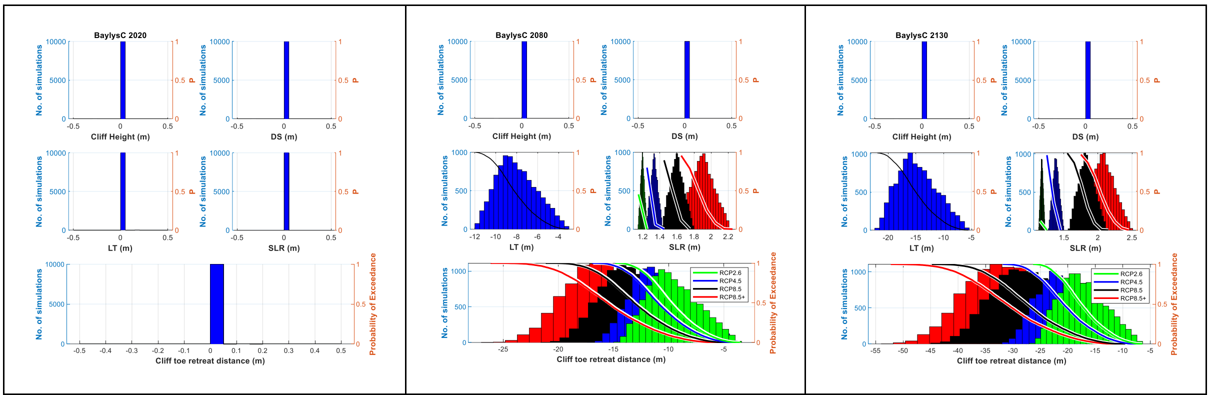
2130

Figure 32.4: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32A



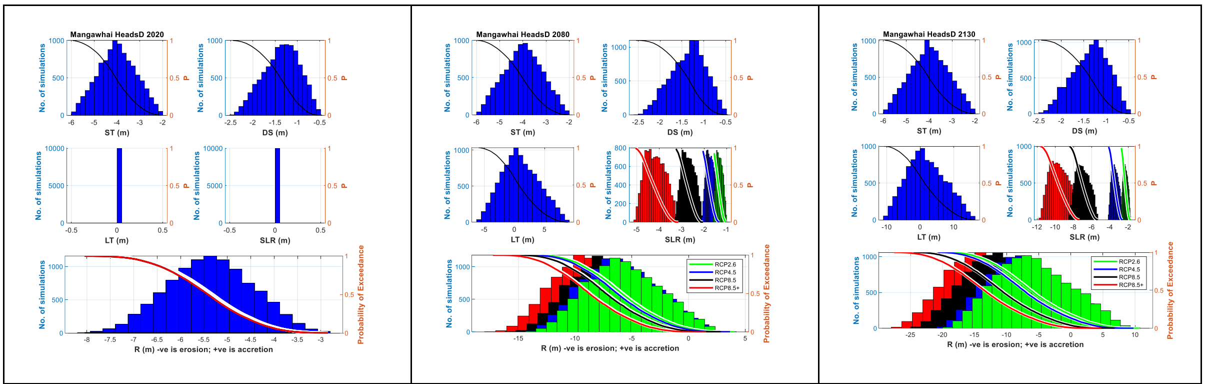
2020	*2080*	*2130*

Figure 32.5: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32B



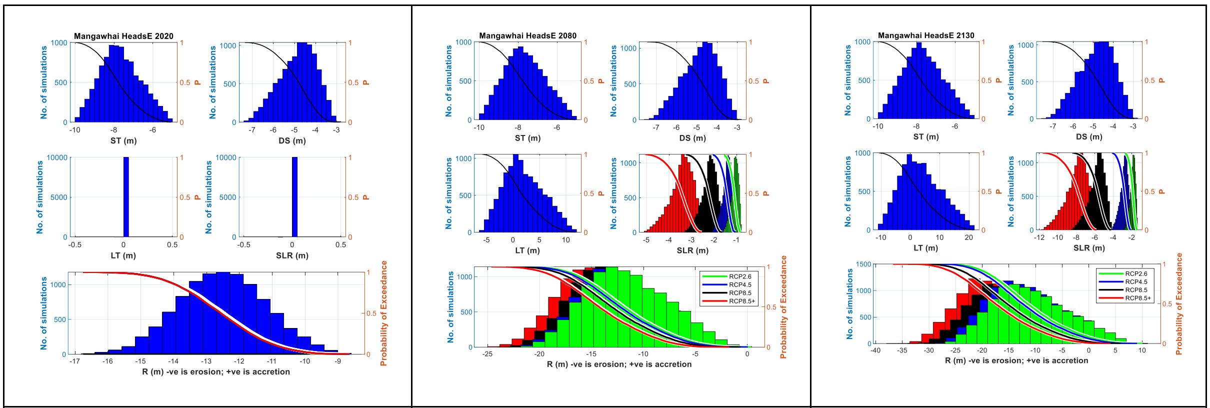
2020	*2080*	*2130*

Figure 32.6: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32C



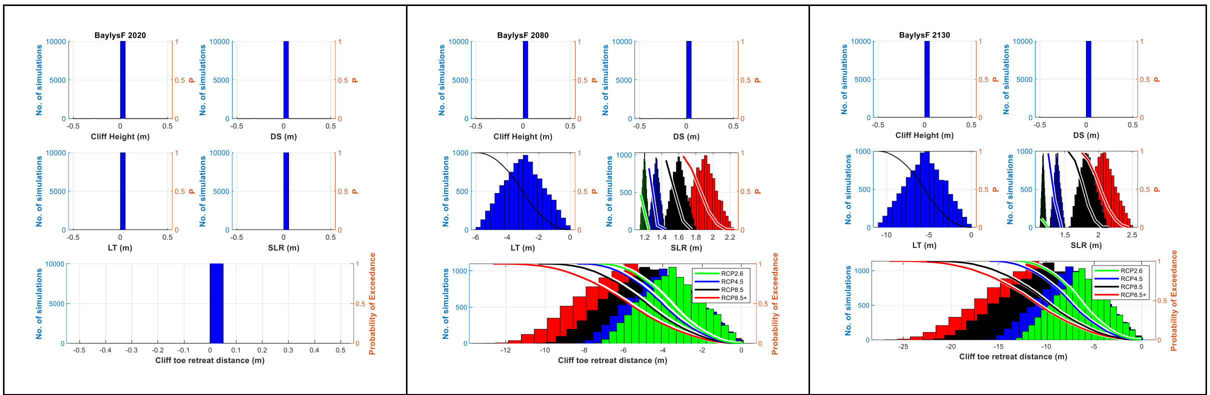
2020	*2080*	*2130*

Figure 32.7: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32D



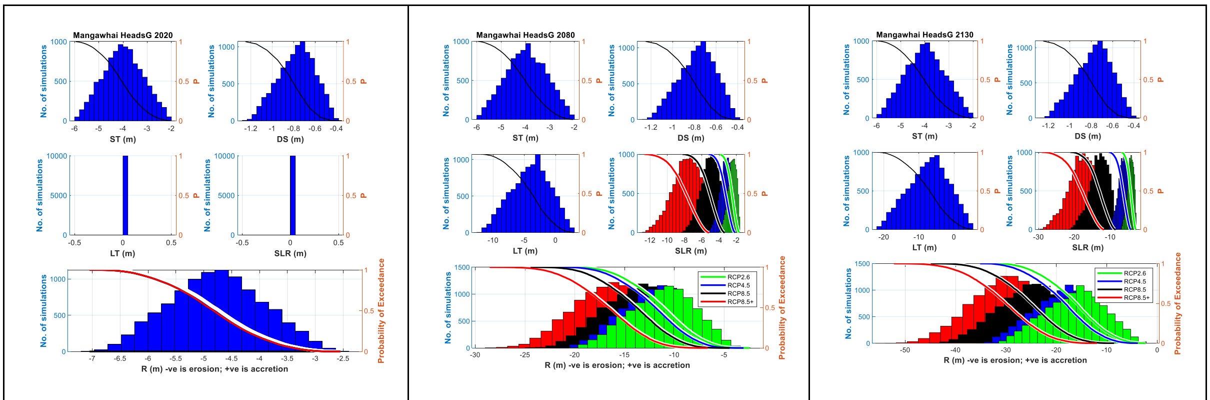
2020	2080	2130

Figure 32.8: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32E



2020	2080	2130

Figure 32.9: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32F



2020	2080	2130

Figure 32.10: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32G

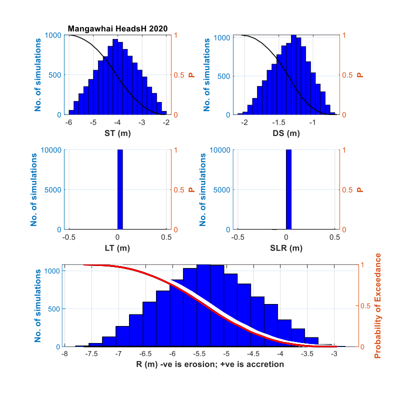
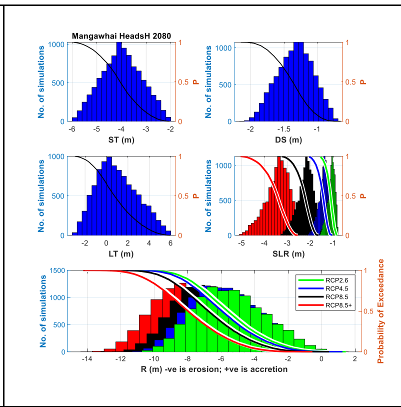
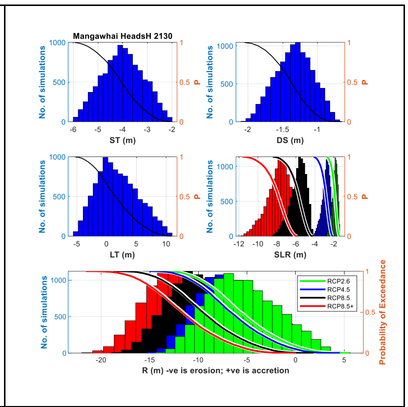
		
2020	*2080*	*2130*

Figure 32.11: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32H

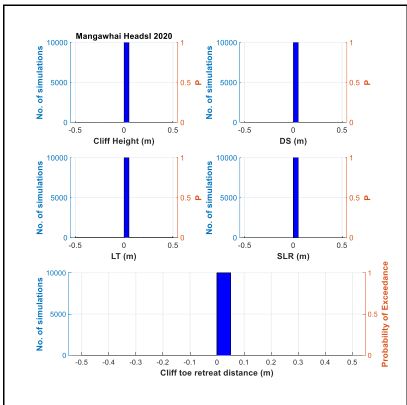
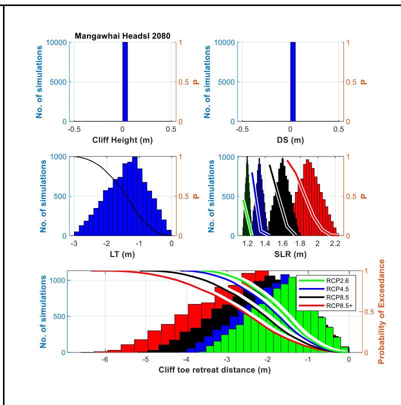
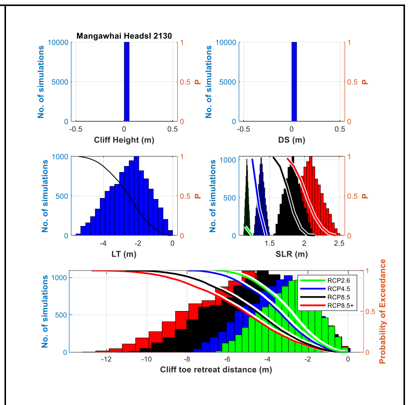
		
2020	*2080*	*2130*

Figure 32.12: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32I

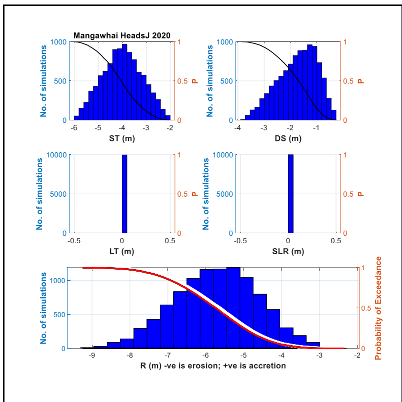
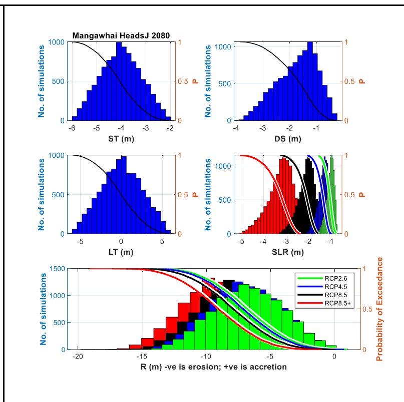
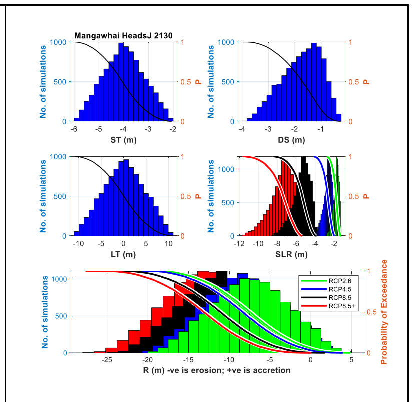
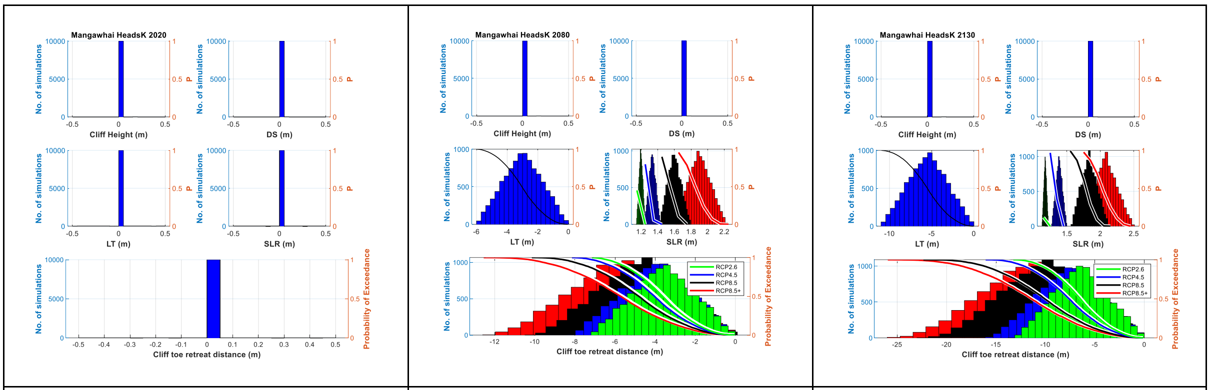
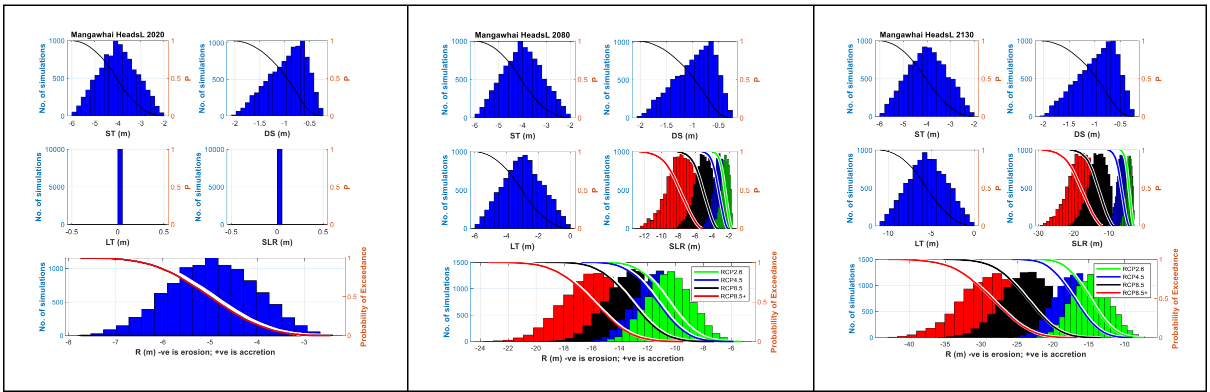
		
2020	*2080*	*2130*

Figure 32.13: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32J



2020	2080	2130

Figure 32.14: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32K



2020	2080	2130

Figure 32.15: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 32L

Table 32.3: Coastal Erosion Hazard Zone Widths (m) Projected for 2020

Site		32. Mangawhai Heads											
	Cell	32A*	32B*	32C*	32D	32E	32*F	32G	32H	32I*	32J	32K*	32L
Probability of CEHZ (m) Exceedance	Min	0	-1	0	-3	-9	0	-3	-3	0	-2	0	-2
	99%	0	-2	0	-3	-10	0	-3	-3	0	-3	0	-3
	95%	0	-3	0	-4	-10	0	-3	-4	0	-4	0	-3
	90%	0	-3	0	-4	-11	0	-4	-4	0	-4	0	-4
	80%	0	-4	0	-5	-11	0	-4	-5	0	-5	0	-4
	70%	0	-5	0	-5	-12	0	-4	-5	0	-5	0	-4
	66%	0	-5	0	-5	-12	0	-4	-5	0	-5	0	-5
	60%	0	-6	0	-5	-12	0	-5	-5	0	-5	0	-5
	50%	0	-7	0	-5	-13	0	-5	-5	0	-6	0	-5
	40%	0	-7	0	-6	-13	0	-5	-6	0	-6	0	-5
	33%	0	-8	0	-6	-13	0	-5	-6	0	-6	0	-5
	30%	0	-8	0	-6	-13	0	-5	-6	0	-6	0	-5
	20%	0	-10	0	-6	-14	0	-6	-6	0	-7	0	-6
	10%	0	-11	0	-7	-14	0	-6	-6	0	-7	0	-6
	5%	0	-12	0	-7	-15	0	-6	-7	0	-8	0	-6
	1%	0	-14	0	-7	-16	0	-7	-7	0	-8	0	-7
	Max	0	-17	0	-8	-17	0	-7	-8	0	-9	0	-8

*Cliff projection method has been used, so cliff toe position has been tabulated, which has been assumed to be unchanged from the adopted 2019 baseline. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 32.4: Coastal Erosion Hazard Zone Widths (m) Projected for 2080

Site		32. Mangawhai Heads																							
Cell		32A				32B				32C				32D				32E				32F			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	0	0	0	0	-4	-4	-5	-5	-1	-2	-2	-2	4	4	3	2	0	0	-1	-2	0	0	0	0
	99%	0	0	0	0	-4	-5	-6	-7	-2	-2	-2	-2	1	1	0	-1	-3	-3	-4	-5	-1	-1	-1	-1
	95%	0	0	0	-1	-5	-6	-7	-8	-2	-2	-2	-3	0	-1	-2	-3	-5	-5	-6	-7	-1	-1	-1	-2
	90%	-1	-1	-1	-1	-6	-7	-8	-9	-2	-2	-2	-3	-1	-2	-3	-4	-6	-6	-7	-8	-2	-2	-2	-2
	80%	-1	-1	-1	-1	-7	-8	-9	-11	-2	-2	-3	-3	-3	-3	-4	-6	-8	-8	-9	-10	-2	-3	-3	-4
	70%	-1	-1	-1	-1	-8	-8	-10	-12	-2	-2	-3	-3	-4	-4	-5	-7	-9	-10	-11	-12	-3	-3	-4	-4
	66%	-1	-1	-1	-2	-8	-9	-10	-12	-2	-2	-3	-3	-4	-5	-6	-7	-10	-10	-11	-12	-3	-3	-4	-5
	60%	-1	-1	-1	-2	-8	-9	-11	-13	-2	-2	-3	-4	-5	-5	-6	-8	-11	-11	-12	-13	-3	-4	-4	-5
	50%	-1	-1	-2	-2	-9	-10	-12	-14	-2	-3	-3	-4	-6	-6	-7	-9	-12	-12	-13	-14	-4	-4	-5	-6
	40%	-2	-2	-2	-2	-9	-10	-13	-15	-2	-3	-3	-4	-7	-7	-8	-10	-13	-13	-14	-15	-4	-4	-5	-6
	33%	-2	-2	-2	-3	-10	-11	-13	-16	-3	-3	-3	-4	-7	-8	-9	-10	-14	-14	-15	-16	-4	-5	-6	-7
	30%	-2	-2	-2	-3	-10	-11	-13	-16	-3	-3	-4	-4	-8	-8	-9	-10	-14	-14	-15	-16	-4	-5	-6	-7
	20%	-2	-2	-3	-3	-11	-12	-14	-17	-3	-3	-4	-4	-9	-9	-10	-11	-15	-15	-16	-17	-5	-6	-7	-8
	10%	-3	-3	-3	-4	-12	-13	-16	-19	-3	-3	-4	-5	-10	-10	-11	-13	-17	-17	-18	-19	-6	-6	-7	-9
	5%	-3	-3	-4	-5	-13	-14	-17	-20	-3	-4	-4	-5	-11	-11	-12	-14	-18	-18	-19	-20	-6	-7	-8	-10
	1%	-3	-4	-4	-5	-14	-15	-19	-22	-3	-4	-5	-6	-12	-13	-14	-15	-19	-20	-21	-22	-7	-8	-9	-11
	Max	-4	-4	-5	-6	-15	-17	-21	-25	-4	-4	-5	-6	-14	-14	-16	-17	-22	-23	-23	-25	-7	-8	-10	-13
	CEHZ1	-1*				-10*				-3*				-10				-15				-4*			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Site		32. Mangawhai Heads																							
Cell		32G				32H				32I				32J				32K				32L			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	-2	-3	-4	-7	1	1	0	-1	0	0	0	0	1	1	0	-1	0	0	0	0	-5	-6	-7	-9
	99%	-5	-6	-7	-9	-1	-1	-2	-3	0	0	0	0	-1	-1	-2	-3	-1	-1	-1	-1	-7	-7	-9	-11
	95%	-6	-7	-9	-11	-2	-2	-3	-4	-1	-1	-1	-1	-2	-3	-3	-4	-1	-1	-2	-2	-8	-9	-10	-12
	90%	-7	-8	-10	-12	-3	-3	-4	-5	-1	-1	-1	-1	-3	-3	-4	-5	-2	-2	-2	-3	-8	-9	-11	-13
	80%	-8	-9	-11	-14	-4	-4	-5	-6	-1	-1	-1	-2	-4	-5	-5	-7	-2	-2	-3	-4	-9	-10	-12	-14
	70%	-9	-10	-12	-15	-4	-5	-5	-7	-1	-1	-2	-2	-5	-6	-6	-7	-3	-3	-4	-4	-10	-10	-12	-15
	66%	-10	-10	-12	-15	-5	-5	-6	-7	-1	-1	-2	-2	-6	-6	-7	-8	-3	-3	-4	-5	-10	-11	-12	-15
	60%	-10	-11	-13	-16	-5	-5	-6	-7	-1	-2	-2	-2	-6	-6	-7	-8	-3	-4	-4	-5	-10	-11	-13	-15
	50%	-11	-12	-14	-17	-6	-6	-7	-8	-2	-2	-2	-3	-7	-7	-8	-9	-4	-4	-5	-6	-10	-11	-13	-16
	40%	-12	-13	-15	-18	-6	-6	-7	-8	-2	-2	-2	-3	-7	-8	-9	-10	-4	-4	-5	-6	-11	-12	-14	-16
	33%	-13	-13	-15	-18	-7	-7	-8	-9	-2	-2	-3	-3	-8	-8	-9	-10	-4	-5	-6	-7	-11	-12	-14	-17
	30%	-13	-14	-16	-19	-7	-7	-8	-9	-2	-2	-3	-3	-8	-9	-9	-10	-4	-5	-6	-7	-11	-12	-14	-17
	20%	-14	-15	-17	-20	-7	-8	-8	-10	-2	-3	-3	-4	-9	-9	-10	-11	-5	-5	-7	-8	-12	-13	-15	-18
	10%	-16	-16	-18	-21	-8	-8	-9	-11	-3	-3	-4	-4	-10	-11	-11	-13	-6	-6	-8	-9	-13	-13	-15	-19
	5%	-17	-18	-20	-23	-9	-9	-10	-11	-3	-3	-4	-5	-11	-12	-12	-14	-6	-7	-8	-10	-13	-14	-16	-19
	1%	-18	-19	-21	-25	-10	-10	-11	-12	-3	-4	-4	-5	-13	-13	-14	-15	-7	-7	-9	-11	-14	-15	-17	-21
	Max	-21	-22	-24	-29	-11	-12	-13	-14	-4	-4	-5	-6	-16	-16	-17	-19	-7	-8	-10	-13	-16	-17	-19	-23
	CEHZ1	-12				-10				-2*				-10				-4*				-12			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 32.5: Coastal Erosion Hazard Zone Widths (m) Projected for 2130

Site		32. Managawhai Heads																							
Cell		32A				32B				32C				32D				32E				32F			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	0	0	0	0	-6	-7	-9	-10	-3	-3	-4	-4	11	10	7	5	10	9	6	4	0	0	0	0
	99%	0	0	0	0	-8	-9	-12	-14	-3	-3	-4	-5	7	6	2	0	5	5	2	0	-1	-1	-1	-1
	95%	-1	-1	-1	-1	-9	-11	-15	-17	-3	-4	-5	-5	4	3	0	-3	2	1	-2	-4	-2	-2	-3	-4
	90%	-1	-1	-1	-2	-11	-13	-17	-19	-3	-4	-5	-6	2	1	-2	-5	-1	-2	-5	-7	-3	-3	-5	-5
	80%	-1	-2	-2	-2	-12	-15	-19	-22	-4	-4	-6	-6	-1	-2	-5	-8	-4	-5	-8	-10	-4	-5	-6	-7
	70%	-2	-2	-3	-3	-14	-16	-21	-24	-4	-4	-6	-7	-3	-4	-7	-10	-7	-8	-11	-13	-5	-6	-8	-9
	66%	-2	-2	-3	-3	-14	-17	-22	-25	-4	-5	-6	-7	-4	-5	-8	-11	-8	-9	-12	-14	-5	-6	-8	-9
	60%	-2	-2	-3	-3	-15	-18	-23	-26	-4	-5	-6	-7	-5	-6	-9	-12	-9	-10	-13	-15	-6	-7	-9	-10
	50%	-2	-3	-4	-4	-16	-19	-25	-28	-4	-5	-7	-8	-6	-7	-11	-13	-11	-12	-15	-18	-7	-8	-10	-12
	40%	-3	-3	-4	-5	-17	-20	-26	-30	-4	-5	-7	-8	-8	-9	-12	-15	-13	-14	-17	-19	-7	-9	-11	-13
	33%	-3	-4	-5	-6	-18	-21	-28	-32	-5	-5	-7	-8	-9	-10	-13	-16	-15	-16	-18	-21	-8	-9	-12	-14
	30%	-3	-4	-5	-6	-18	-21	-28	-32	-5	-6	-7	-8	-9	-10	-14	-17	-15	-16	-19	-21	-8	-9	-13	-14
	20%	-4	-5	-6	-7	-20	-23	-31	-35	-5	-6	-8	-9	-11	-12	-16	-18	-17	-18	-21	-23	-9	-10	-14	-16
	10%	-5	-5	-7	-8	-22	-25	-34	-39	-5	-6	-9	-10	-13	-14	-18	-21	-19	-20	-23	-26	-10	-12	-16	-18
	5%	-5	-6	-8	-9	-23	-27	-36	-41	-6	-7	-9	-10	-15	-16	-20	-22	-21	-22	-25	-28	-11	-13	-17	-20
	1%	-6	-7	-9	-11	-24	-29	-39	-45	-6	-7	-10	-12	-17	-18	-22	-25	-24	-25	-28	-30	-12	-14	-19	-22
	Max	-7	-8	-11	-13	-26	-32	-45	-52	-7	-8	-11	-13	-19	-21	-25	-28	-29	-30	-34	-37	-13	-16	-22	-26
	CEHZ2	-8*				-36*				-9*				-25				-35				-17*			
	CEHZ3	-9*				-41*				-10*				-25				-35				-20*			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Site		32. Managawhai Heads																							
Cell		32G				32H				32I				32J				32K				32L			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	-2	-4	-9	-12	6	5	2	0	0	0	0	0	5	4	2	0	0	0	0	0	-7	-9	-13	-17
	99%	-5	-7	-12	-16	3	2	-1	-3	0	-1	-1	-1	2	1	-1	-3	-1	-1	-1	-2	-9	-11	-16	-20
	95%	-7	-9	-15	-20	1	0	-3	-5	-1	-1	-1	-2	0	-1	-3	-5	-2	-2	-3	-4	-11	-13	-18	-22
	90%	-9	-11	-17	-22	0	-1	-4	-6	-1	-2	-2	-2	-1	-2	-5	-7	-3	-3	-4	-5	-11	-13	-19	-23
	80%	-11	-13	-20	-24	-2	-3	-6	-8	-2	-2	-3	-3	-3	-4	-7	-9	-4	-5	-6	-7	-13	-15	-21	-25
	70%	-13	-15	-22	-26	-4	-4	-7	-10	-2	-3	-3	-4	-5	-6	-8	-11	-5	-6	-8	-9	-13	-15	-22	-26
	66%	-14	-16	-22	-27	-4	-5	-8	-10	-2	-3	-4	-4	-5	-6	-9	-11	-5	-6	-8	-9	-14	-16	-22	-27
	60%	-15	-17	-23	-28	-5	-6	-8	-11	-3	-3	-4	-5	-6	-7	-10	-12	-6	-7	-9	-10	-14	-16	-23	-27
	50%	-16	-18	-25	-30	-6	-7	-10	-12	-3	-3	-5	-5	-7	-8	-11	-13	-7	-8	-10	-12	-15	-17	-24	-28
	40%	-18	-20	-27	-32	-7	-8	-10	-13	-3	-4	-5	-6	-9	-10	-12	-14	-7	-8	-11	-13	-15	-18	-24	-30
	33%	-19	-21	-28	-33	-7	-8	-11	-13	-4	-4	-6	-6	-10	-11	-13	-15	-8	-9	-12	-14	-16	-18	-25	-30
	30%	-20	-22	-29	-34	-8	-9	-11	-14	-4	-4	-6	-7	-10	-11	-14	-16	-8	-9	-12	-14	-16	-18	-25	-31
	20%	-22	-24	-31	-36	-9	-10	-12	-15	-4	-5	-7	-7	-12	-12	-15	-17	-9	-10	-14	-16	-17	-19	-27	-32
	10%	-24	-27	-34	-39	-10	-11	-14	-16	-5	-6	-8	-9	-14	-15	-17	-20	-10	-12	-16	-18	-18	-21	-28	-34
	5%	-26	-29	-36	-42	-11	-12	-15	-17	-5	-6	-8	-10	-15	-16	-19	-21	-11	-13	-17	-20	-19	-21	-30	-36
	1%	-29	-32	-40	-46	-12	-13	-16	-19	-6	-7	-9	-11	-17	-18	-21	-24	-12	-14	-19	-22	-20	-23	-32	-39
	Max	-32	-35	-45	-52	-14	-15	-19	-22	-7	-8	-11	-13	-20	-21	-25	-28	-13	-16	-22	-26	-23	-26	-35	-43
	CEHZ2	-36				-25				-8*				-25				-17*				-30*			
	CEHZ3	-42				-25				-10*				-25				-20*				-36*			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 32.6: Summary of CEHZ distances for cliff cells mapped using cliff projection method

	CEHZ1			CEHZ2			CEHZ3		
Cell	**Min (m)**	**Average (m)**	**Max (m)**	**Min (m)**	**Average (m)**	**Max (m)**	**Min (m)**	**Average (m)**	**Max (m)**
32A	-1	-37	-55	-27	-56	-68	-28	-57	-69
32B	-11	-26	-37	-60	-66	-70	-66	-72	-76
32C	-4	-21	-44	-19	-45	-92	-21	-47	-93
32F	-5	-24	-46	-18	-44	-68	-21	-49	-84
32I	-3	-13	-40	-9	-22	-61	-11	-24	-63
32K	-7	-24	-28	-36	-44	-51	-39	-47	-55

Path: P:\1012360\WorkingMaterial\GIS\CEHZ maps\1012360_CEHZ001_v2.mxd Date: 29/05/2020 Time: 6:10:10 am

Notes: Dashed CEHZ indicates greater uncertainty around stream mouths and backshore topography. Northland 0.4m Rural Aerial Photos (2014-2016).

A4 SCALE 1:20,000

0 0.2 0.4 0.6 0.8 1 (km)

Tonkin+Taylor
105 Carlton Gore Rd, Newmarket, Auckland
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SCALE (AT A4 SIZE) 1:20,000		
PROJECT No. 1012360		

NORTHLAND REGIONAL COUNCIL
Coastal Erosion Hazard Assessment
Mangawhai Heads
Site: 32

FIGURE No. Figure 32-16

Rev. 1

Path: P:\1012360\WorkingMaterial\GIS\CEHZ maps\1012360_Historicv2.mxd Date: 9/06/2020 Time: 9:24:26 AM

Notes: Dashed CEHZ indicates greater uncertainty around stream mouths and backshore topography.
Northland 0.4m Rural Aerial Photos (2014-2016).

A4 SCALE 1:20,000

0 0.2 0.4 0.6 0.8 1 (km)

N

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1012360_Historicv2.mxd

SCALE (AT A4 SIZE)
1:20,000

PROJECT No.
1012360

NORTHLAND REGIONAL COUNCIL

Historic Shorelines

Mangawhai Heads

Site: 32

FIGURE No.
Figure 32-17

Rev.
1