Coastal inundation and sea level rise exposure assessment for Nauru

CIVRA

July 2025

Document version

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0-1	14th November 2025	Nathan Eaton	Final Draft
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NGIS

1 Introduction

Exposure of Nauru Infrastructure to coastal inundation is presented in this report for various sea level rise increments to support the information presented in the NAURU Climate Impacts, Vulnerability and Risk Assessment (CIVRA). This coastal inundation information presented here enables the identification of locations to focus more detailed investigation of the potential impacts and management implication of coastal flooding in Nauru under future sea level rise.

2 Method

Inundation layers analysed here are sourced from NIWA's recent reporting prepared for the Nauru Higher Ground Initiative (HGI) project which aimed to incorporate sea level rise (SLR) projection considerations into the current Nauru Higher Ground Rehabilitation Project [1, 2]. This report presents data aligned with the second phase (Stage 2) of coastal inundation hazard exposure modelling analysis in Nauru, which assessed a combination of wave and storm tides corresponding to a 5–10-year average return interval as well as selected SLR increments [1]. In the previous (Stage 1) analysis by Allis et al. (2020) [2], the wave contribution to coastal inundation hazard was not included only static SLR models.

The Boserelle and Williams (2023) [1], seamless bathymetry and topography digital elevation model (DEM) were accessed to enable coastal inundation simulations of Nauru. A combination of wave and storm tides corresponding to a 5–10-year average return interval are presented. Four SLR increments were selected for this CIVRA high-level study; 0.5, 1, 1.5 and 2 m above present-day king-tide elevation. Using the SROCC higher and lower emissions trajectories, the earliest occurrence of these sea levels is 2070, 2110, 2150, 2190, respectively, but they may not occur for centuries under the most optimistic (low emissions) trajectories but could occur sooner if global emissions are unrestrained (*Table 1*). (Also see Caveats, data limitations and recommendations for future improvement section at the end of this report).

Table 1 Future sea level rise increments incorporated into the Nauru inundation assessments. Note: Values linearly interpolated from IPCC SROCC values. Values shown as median (50th centile), with likely range indicating the 17th–83rd percentile range. Shaded column indicates elevations modelled in this study. (SLR data source: [3] as for [1, 2]).

SLR Increment (m)	Decade of projected SLR occurrence		Elevation of mean sea-level in Nauru after sea-level rise (m NID)	Proportion of high tides above present-day KT1* elevation (%)	Number of high tides per year above present-day KT1* elevation	Number of days per year with high tide above present day KT1* elevation
	Low emissions RCP2.6 (median)	High emissions RCP8.5 (median)				
0.5m	2130 (2080-2220)	2070 (2060-2090)	1.9m	30%	212	109
1m	Beyond 2300	2110 (2090-2150)	2.4m	86.5%	610	315
1.5m	Beyond 2300	2150 (2120-2220)	2.9m	99.9%	705 (every high tide)	365

2m	Beyond 2300	2190 (2150-2270)	3.4m	100%	706 (every high tide)	365

* The selected event approximates a present-day king-tide sea level elevation with 1% annual exceedance probability. This is 2.7 m elevation relative to Nauru Island Datum (NID), i.e., KT1 = 2.7 m NID. This means that through 1993-2009 only 1% of all high tides each year are higher than this elevation at present-day sea levels, and there were approximately 5 tides above this elevation each year. The baseline coastal flooding elevation was determined from the "king-tide" elevation established from the tide gauge data from 1993-2019.

The Sea Level Rise scenario inundation models were then combined/ overlain with the asset layers used in the Stage 1 analysis to calculate the exposure of assets-at-risk (SPC 1 m gridded lidar topography (2014)) [2].

Exposure Overview

2.1 Buildings

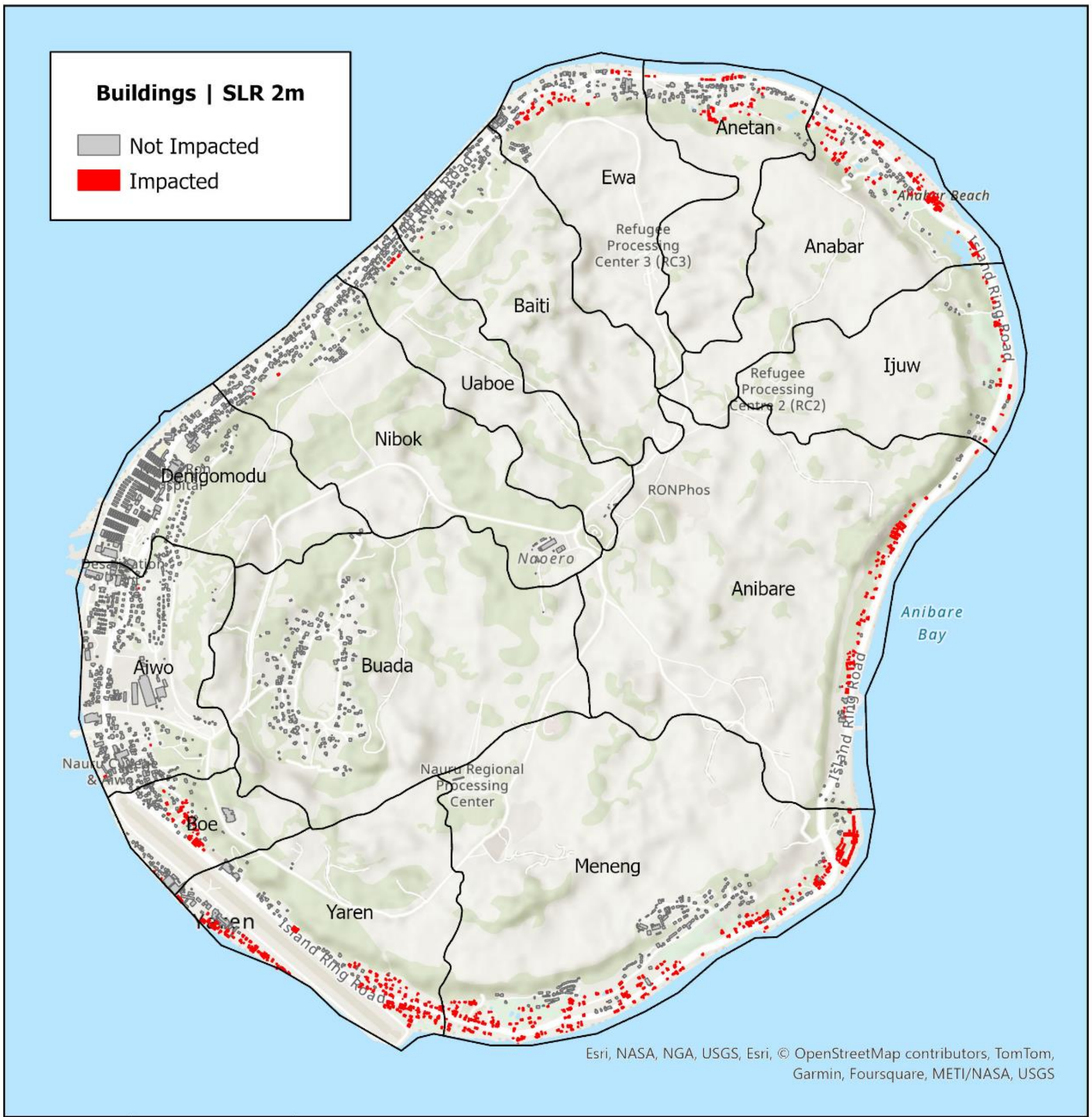
Nauru buildings are distributed around the entire coastline of Nauru including an inland concentration in the district of Buada. There are approximately 2500 separate buildings in Nauru with the largest concentrations being in the Districts of Aiwo (414 buildings) and Denigomodu (229 buildings) on the West Coast and Meneng (360 Buildings) on the South East Coast.

The increase in building impact (Figure 2) for a Sea Level Rise Scenario of 1m compared to 0.5m more than doubles the number of buildings impacted across Nauru (from 3 % to 7 %). The districts of Anabar and Meneng that had the greatest impact at a Sea Level Rise Scenario of 0.5m were still the districts that represented the highest impact at a Sea Level Rise Scenario of 1m, with 18 % and 16 % of buildings impacted respectively. The Eastern District of Anibare that had 6 % of buildings impacted at a Sea Level Rise Scenario of 0.5m saw a significant increase of buildings impacted for the 1m Sea Level Rise Scenario, resulting in 18 % of buildings impacted.

The Sea Level Rise Scenario of 1.5m resulted in the most significant increase of buildings impacted for the scenarios modelled, with the percentage of buildings impacted across Nauru jumping from 7% at the 1m Sea Level Rise Scenario to 17% under the 1.5m Sea Level Rise Scenario. The districts of Anabar, Meneng and Anibare were again impacted the most, with 50% of all buildings at Anabar impacted at a Sea Level Rise Scenario of 1.5m (up from 18%), 47% of buildings impacted for Anibare (up from 16%) and 44% of buildings impacted for Meneng (up from 26%). The location with the most significant increase in the number of buildings impacted between the Sea Level Rise Scenarios of 1m and 1.5m was Yaren, increasing from 4% to 33%. The district of Yaren is the location for a number of critical infrastructures including the Nauru airport, Fire Station and Parliament House (refer to the Critical Infrastructure section).

Under a Sea Level Rise Scenario of 0.5m (earliest occurrence median year of 2070, see *Table 1*) approximately 3 % of all buildings across Nauru would be impacted by inundation. Under this scenario the most impacted districts would be Anabar (9 % of 149 Buildings) on the North East coast (Figure 3) and Meneng (11 % of 360 buildings) on the South East (Figure 4).

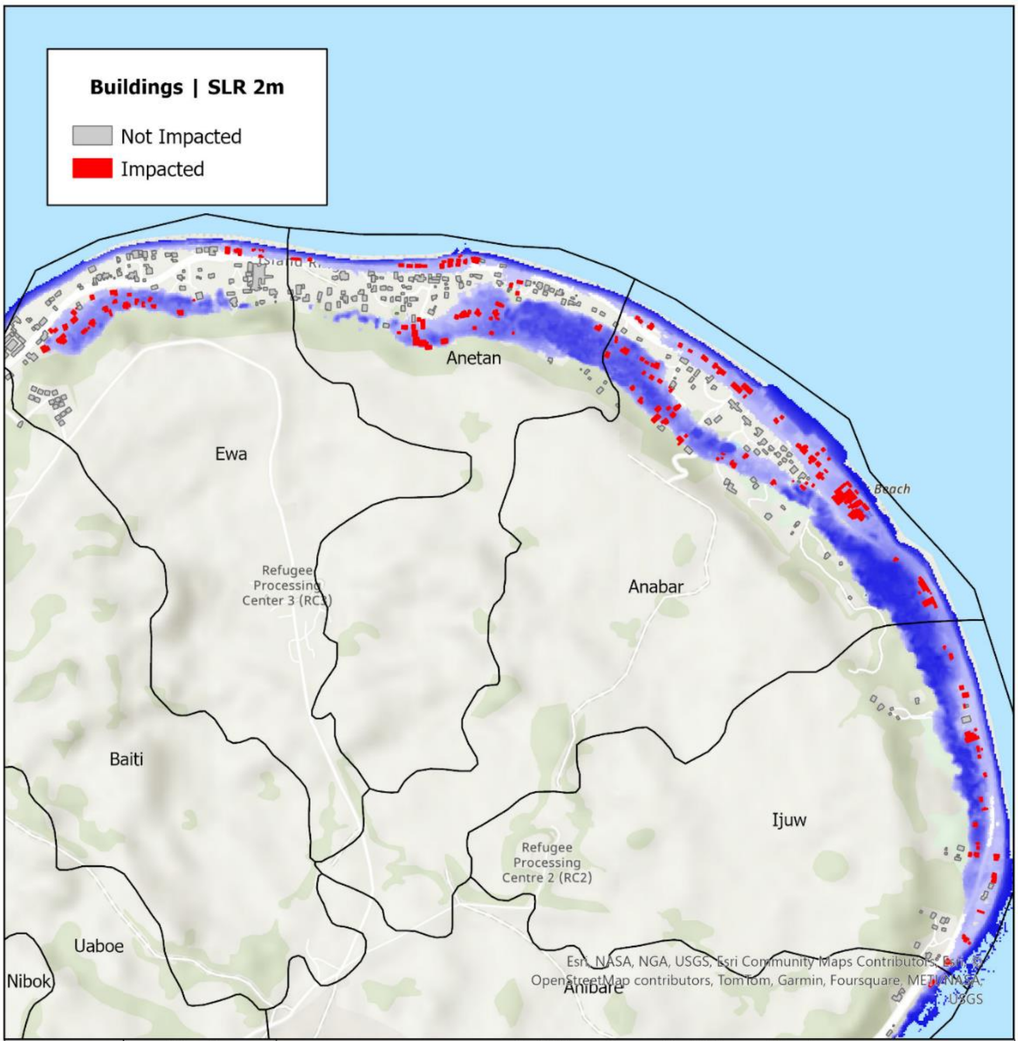
Under a 2m Sea Level Rise Scenario over a quarter of all buildings across Nauru are impacted, with the entire East Coast being impacted more than the West Coast (72% of buildings impacted for the district of Anibare on the East Coast compared with only 1% of buildings impacted in the district of Aiwo on the West Coast) (Figure 5). The two West Coast districts with the highest number of buildings (Aiwo and Denigomodu) were both impacted to a minor level with under 1% of buildings impacted in these districts. The Southern district of Yaren would see a significant increase of buildings impacted under a Sea Level Rise Scenario of 2m, jumping to 65% of all buildings impacted. This would include the South Eastern end of the Nauru Airport which is located in a particularly low lying area.



Area	Number Buildings	Buildings Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	2471	3%	7%	17%	26%
Aiwo	414	0%	0%	0%	1%
Anabar	149	9%	18%	50%	66%
Anetan	130	3%	8%	17%	32%
Anibare	104	6%	16%	47%	72%
Baiti	111	0%	0%	0%	1%
Boe	151	0%	1%	5%	20%
Buada	185	0%	0%	0%	0%
Denigomodu	229	0%	0%	0%	0%
Ewa	123	7%	12%	19%	27%
Ijuw	52	6%	12%	31%	50%
Meneng	360	11%	26%	44%	58%
Nibok	164	0%	0%	1%	1%
Uaboe	68	0%	0%	1%	6%
Yaren	186	2%	4%	33%	65%

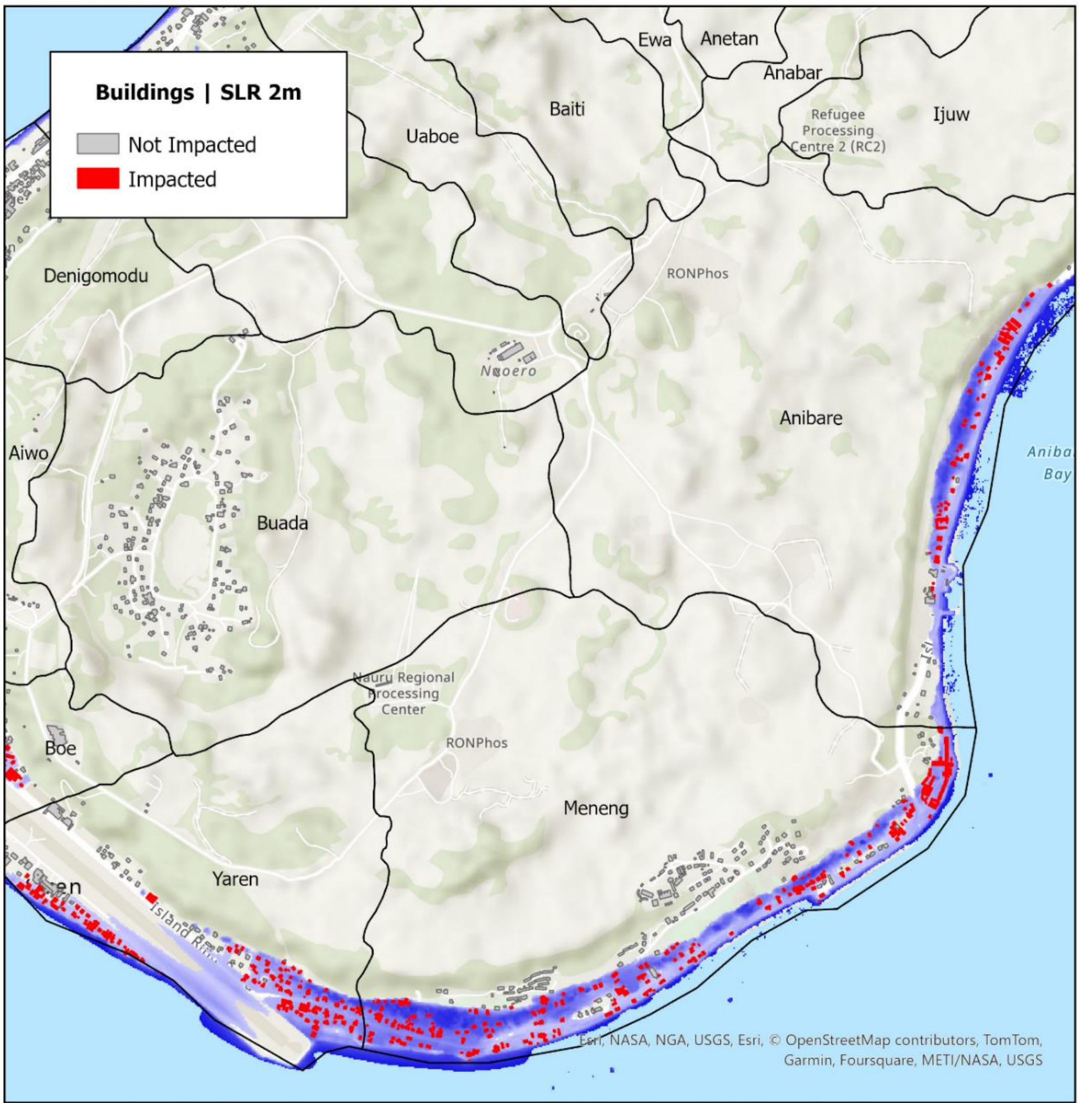
Figure 1 Nauru Buildings impacted by coastal inundation relating to 2m of Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted buildings shown in red, and non-impacted buildings shown in grey (top).

Number of buildings and percentage inundated across Nauru (all) and the different districts under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Number Buildings	Buildings Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	2471	3%	7%	17%	26%
Aiwo	414	0%	0%	0%	1%
Anabar	149	9%	18%	50%	66%
Anetan	130	3%	8%	17%	32%
Anibare	104	6%	16%	47%	72%
Baiti	111	0%	0%	0%	1%
Boe	151	0%	1%	5%	20%
Buada	185	0%	0%	0%	0%
Denigomodu	229	0%	0%	0%	0%
Ewa	123	7%	12%	19%	27%
Ijuw	52	6%	12%	31%	50%
Meneng	360	11%	26%	44%	58%
Nibok	164	0%	0%	1%	1%
Uaboe	68	0%	0%	1%	6%
Yaren	186	2%	4%	33%	65%

Figure 2 North East Nauru District Buildings impacted by coastal inundation relating to 2m Sea Level Rise (blue shading) (occurring ~2190 at earliest see Table 1) with impacted buildings shown in red, and non-impacted buildings shown in grey (top). Number of buildings and percentage inundated across Nauru (all) and the North East districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Number Buildings	Buildings Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	2471	3%	7%	17%	26%
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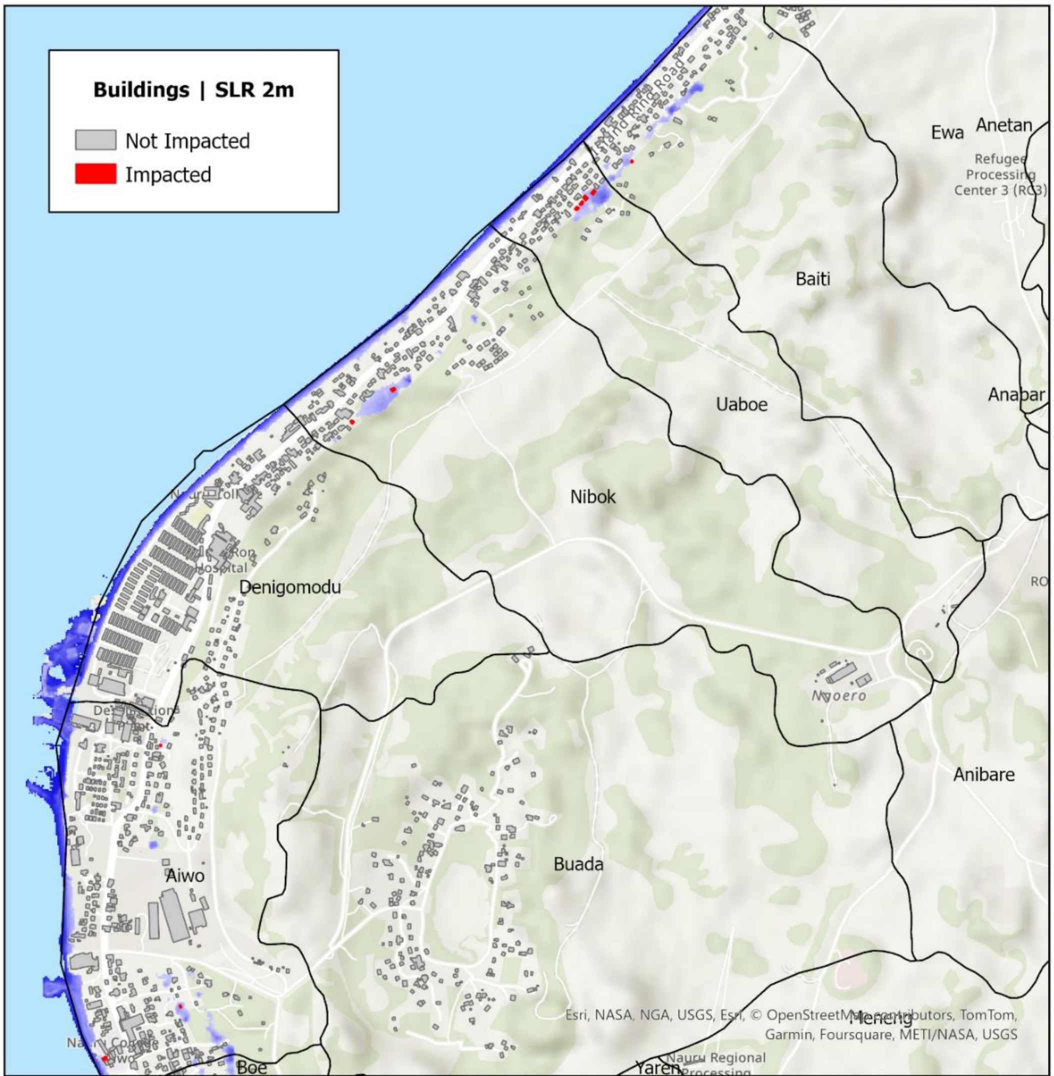
Anabar	149	9%	18%	50%	66%
Anetan	130	3%	8%	17%	32%
Anibare	104	6%	16%	47%	72%
Baiti	111	0%	0%	0%	1%
Boe	151	0%	1%	5%	20%
Buada	185	0%	0%	0%	0%
Denigomodu	229	0%	0%	0%	0%
Ewa	123	7%	12%	19%	27%
Ijuw	52	6%	12%	31%	50%
Meneng	360	11%	26%	44%	58%
Nibok	164	0%	0%	1%	1%
Uaboe	68	0%	0%	1%	6%
Yaren	186	2%	4%	33%	65%

Figure 3 South East Nauru District buildings impacted by coastal inundation relating to 2m Sea Level Rise (blue shading) (occurring ~2190 at earliest see Table 1) with impacted buildings shown in red, and non-impacted buildings shown in grey (top). Number of buildings and percentage inundated across Nauru (all) and the South East districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Number Buildings	Buildings Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	2471	3%	7%	17%	26%
Aiwo	414	0%	0%	0%	1%
Anabar	149	9%	18%	50%	66%
Anetan	130	3%	8%	17%	32%
Anibare	104	6%	16%	47%	72%
Baiti	111	0%	0%	0%	1%
Boe	151	0%	1%	5%	20%
Buada	185	0%	0%	0%	0%
Denigomodu	229	0%	0%	0%	0%
Ewa	123	7%	12%	19%	27%
Ijuw	52	6%	12%	31%	50%
Meneng	360	11%	26%	44%	58%
Nibok	164	0%	0%	1%	1%
Uaboe	68	0%	0%	1%	6%
Yaren	186	2%	4%	33%	65%

Figure 4 West Nauru District Buildings impacted by coastal inundation relating to 2m of Sea Level Rise (blue shading) (occurring ~2190 at earliest see Table 1) with impacted buildings shown in red, and non-impacted buildings shown in grey (top). Number of buildings and percentage inundated across Nauru (all) and the West districts (green highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

2.2 Coconut Crops

Nauru has over 100 hectares of 'Coconut Crops' distributed across the entire Island. The exposure of coconut crops to rising sea levels was requested as a proxy for potentially productive land area as related to food security concerns for the Island [2]. The majority of Nauru Coconut Crops are located in the Districts of Buada (around 20% of all Coconut Crops) and Meneng (around 15 % of all Coconut Crops). On the East Coast of Nauru the majority of Coconut Crops are located in close proximity to the coastline, where on the West Coast the Coconut Crops tend to be located further inland such as in the central district of Buada.

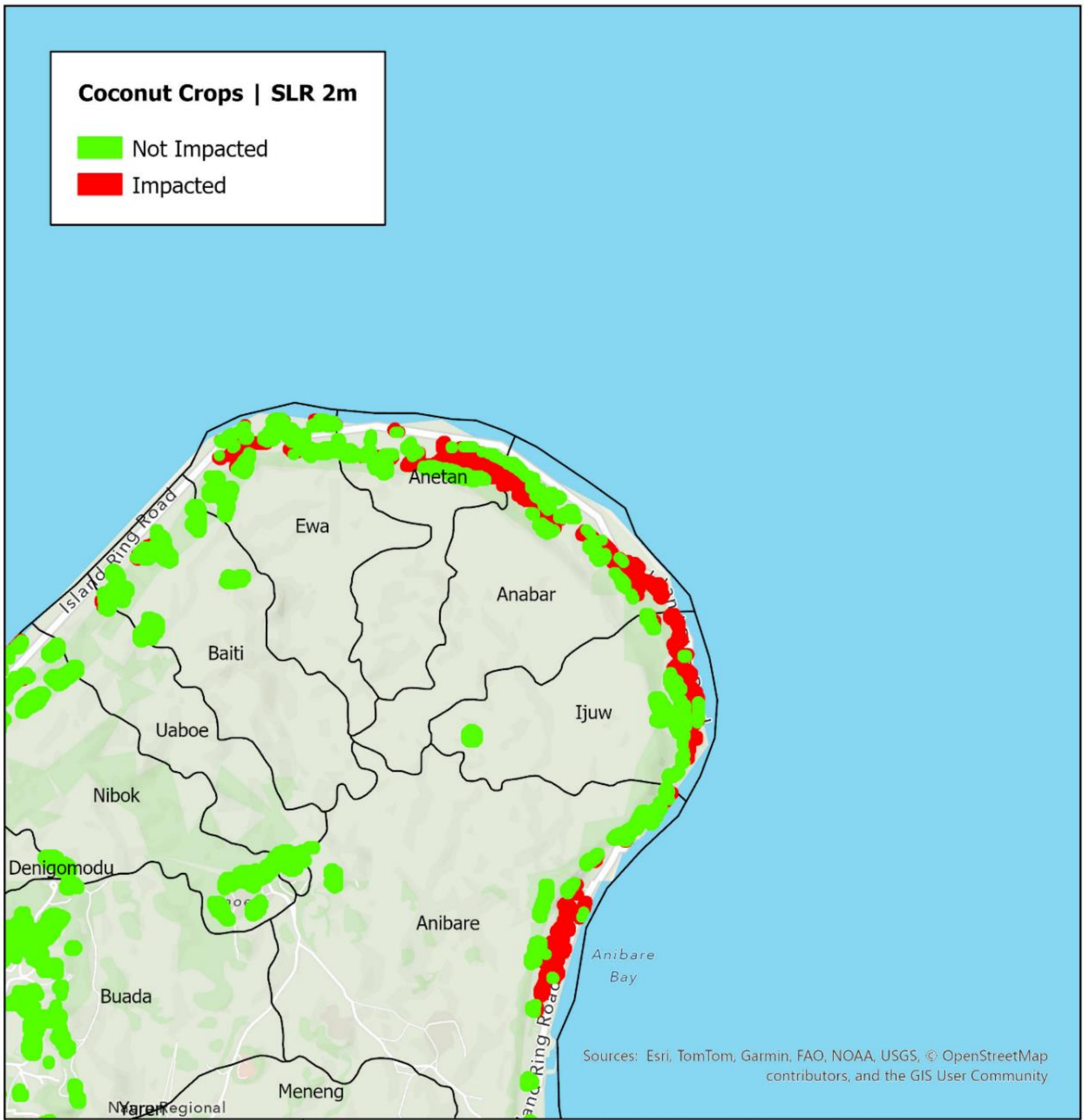
Under a Sea Level Rise Scenario of 0.5m around 13 % (*Figure 5*) of all Coconut Crops across Nauru are impacted, with the majority of impact located in the East Districts. Under this scenario the Districts of Anabar and Anetan have the highest level of impact, with 38 % and 42 % of crops impacted respectively. The district of Buada with the largest amount of Coconut Crops sees no impact under a 0.5m Sea Level Rise.

Under a 1m Sea Level Rise the percentage of Coconut Crops impacted across Nauru increases to 20 %, with over 50 % of the crops in the districts of Anabar and Anetan impacted. The District of Meneng which has the second largest area of Coconut Crops of any district sees 37 % of crops impacted by inundation at the Sea Level Rise Scenario of 1m, increasing from 22 % of crops impacted under a Sea Level Rise Scenario of 0.5m (*Figure 6*).

The impact of a 1.5m sea level rise represents over a quarter of all coconut crops inundated with the districts of Anabar, Anetan and Meneng continuing to be the districts with the highest level of impacted (68 %, 59 % and 55 % of crops impacted respectively). The District of Yaren has 35 % of all Coconut Crops impacted by a Sea Level Rise Scenario of 1.5m, almost tripling the level of impact compared to the Sea Level Rise Scenario of 0.5m where only 12 % of crops were impacted.

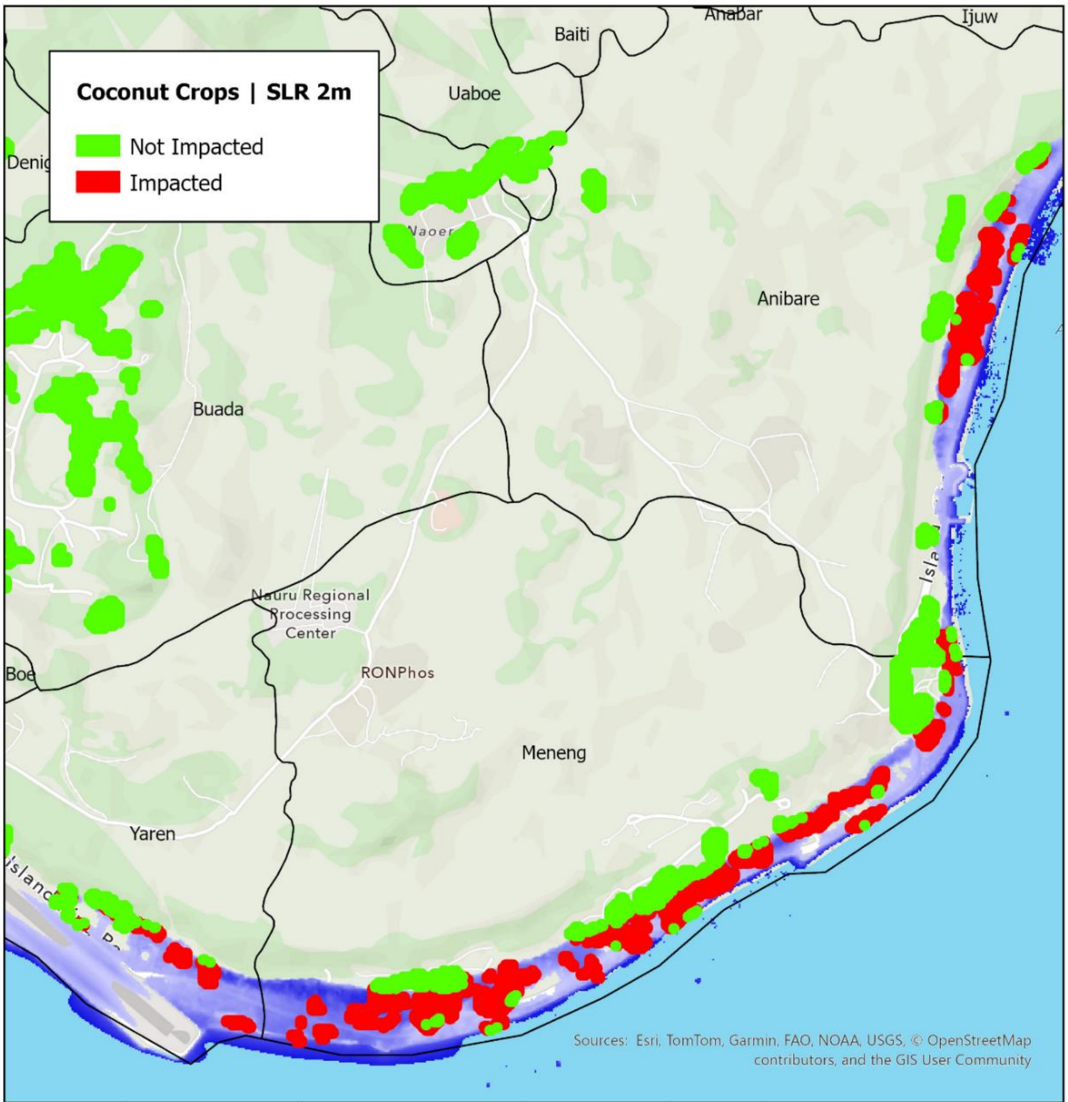
Under a Sea Level Rise Scenario of 2m around a third of all Coconut Crops are impacted across Nauru. The East Districts of Nauru are impacted the most, with Anabar, Anetan, Ijuw and Yaren all having more than 50% of all coconut crops impacted (*Figure 5* and *Figure 6*). The Buada District which has the highest are of Coconut Crops continues to be resilient to sea level rise, with no crops impacted by a 2m Sea Level Rise Scenario (*Figure 8*).

The West Districts of Nauru are the most resilient to a 2m Sea Level Rise Scenario with the Districts of Uaboe, Nibok, Buada and Aiwo all having less than 5% of all crops impacted. The District of Boe on the South West Corner of Nauru sees almost 50% of all coconut crops impacted under a Sea Level Rise Scenario of 2m, although Boe has the smallest area of Coconut Crops of any District in Nauru (*Figure 8*).



Area	Coconut Crops (m2)	Coconut Crops Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	1095050	13%	20%	28%	33%
Aiwo	45525	0%	1%	1%	5%
Anabar	94700	38%	52%	68%	74%
Anetan	84500	42%	51%	59%	66%
Anibare	90650	17%	26%	36%	40%
Baiti	57550	1%	3%	5%	12%
Boe	18075	17%	26%	37%	48%
Buada	212450	0%	0%	0%	0%
Denigomodu	48325	0%	0%	0%	0%
Ewa	60025	6%	15%	21%	30%
Ijuw	75675	18%	27%	43%	53%
Meneng	157925	22%	37%	55%	68%
Nibok	95700	0%	0%	1%	2%
Uaboe	16875	0%	0%	1%	1%
Yaren	35175	12%	19%	35%	50%

Figure 5 North Eastern Nauru Coconut crops impacted by coastal inundation relating to 2m Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted crops shown in red, and non-impacted crops shown in green (top). Number of coconut crops and percentage inundated across Nauru (all) and the different districts under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Coconut Crops (m2)	Coconut Crops Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	1095050	13%	20%	28%	33%
Aiwo	45525	0%	1%	1%	5%
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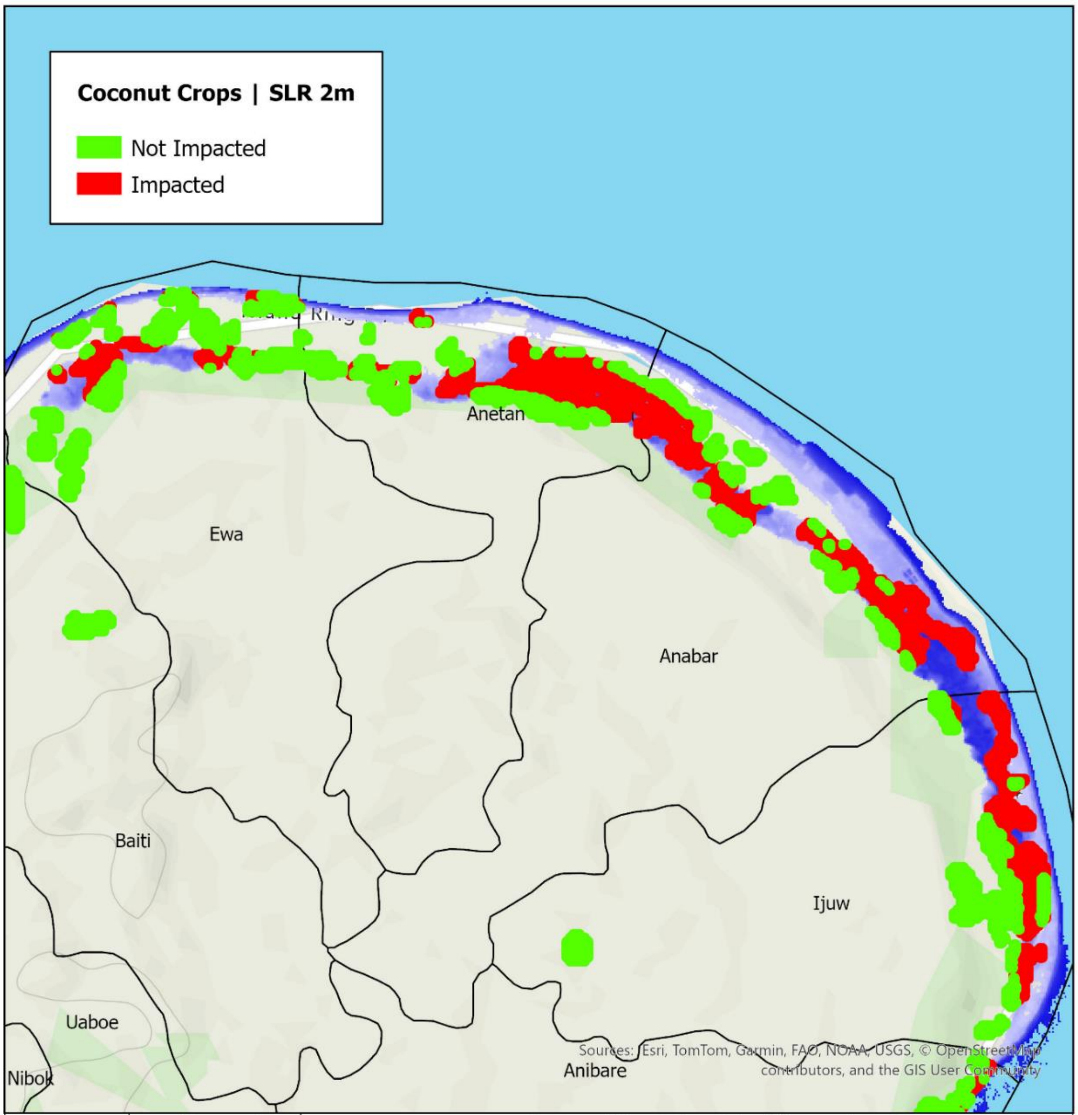
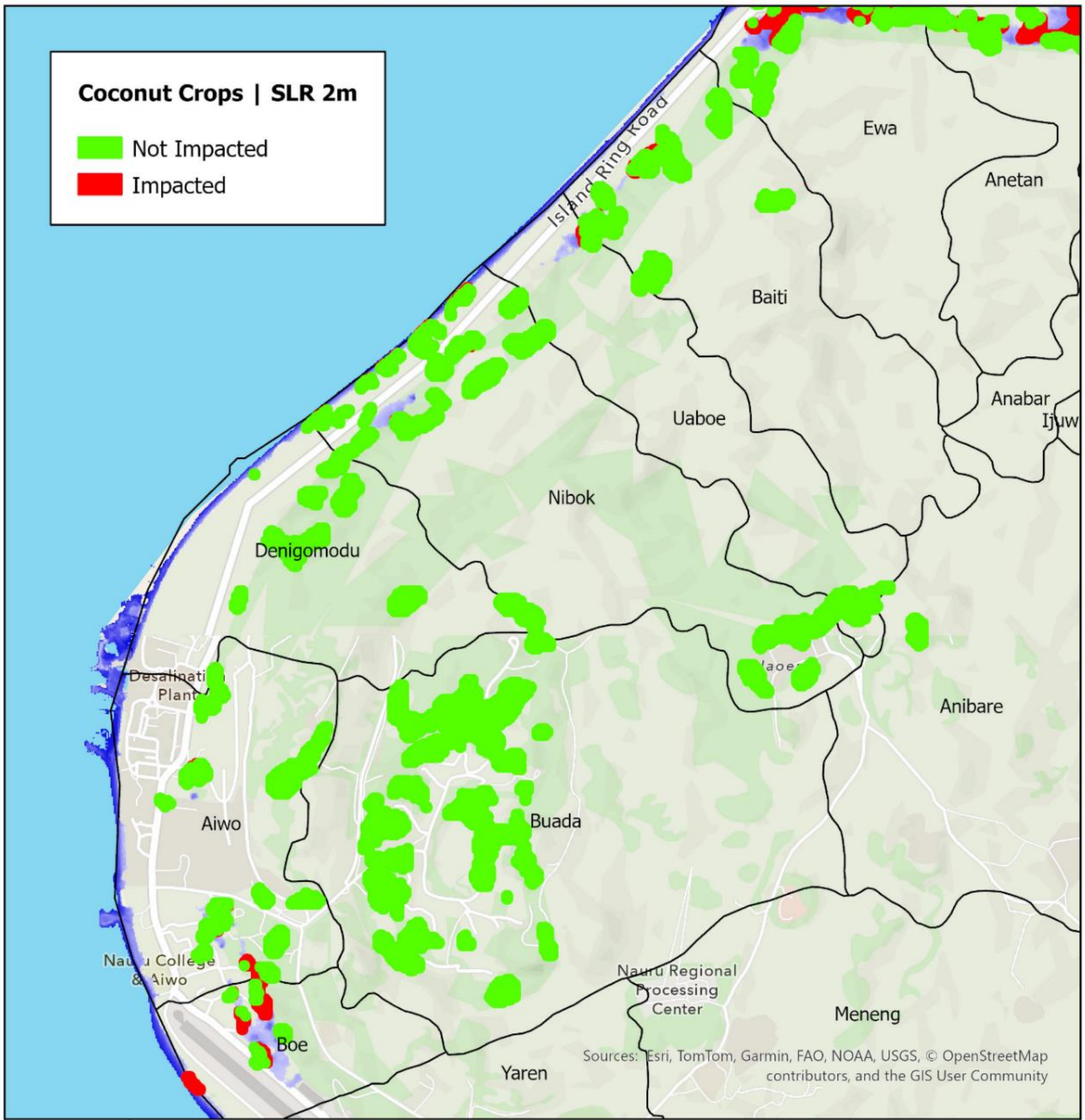
Nibok	95700	0%	0%	1%	2%
Uaboe	16875	0%	0%	1%	1%
Yaren	35175	12%	19%	35%	50%

Figure 6 South East Districts Coconut Crops Impacted by coastal inundation relating to 2m Sea Level Rise (blue shading) (occurring ~2190 at earliest see Table 1) with impacted crops shown in red, and non-impacted crops shown in green (top). Number of buildings and percentage inundated across Nauru (all) and the South East districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Coconut Crops (m2)	Coconut Crops Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	1095050	13%	20%	28%	33%
Aiwo	45525	0%	1%	1%	5%
Anabar	94700	38%	52%	68%	74%
Anetan	84500	42%	51%	59%	66%
Anibare	90650	17%	26%	36%	40%
Baiti	57550	1%	3%	5%	12%
Boe	18075	17%	26%	37%	48%
Buada	212450	0%	0%	0%	0%
Denigomodu	48325	0%	0%	0%	0%
Ewa	60025	6%	15%	21%	30%
Ijuw	75675	18%	27%	43%	53%
Meneng	157925	22%	37%	55%	68%
Nibok	95700	0%	0%	1%	2%
Uaboe	16875	0%	0%	1%	1%
Yaren	35175	12%	19%	35%	50%

Figure 7 North Nauru Coconut crops impacted by coastal inundation relating to 2m Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted crops shown in red, and non-impacted crops shown in green (top). Number of coconut crops and percentage inundated across Nauru (all) and the northern districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Coconut Crops (m2)	Coconut Crops Impacted (Percentage)			
		0.5m	1m	1.5m	2m
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Anabar	94700	38%	52%	68%	74%
Anetan	84500	42%	51%	59%	66%
Anibare	90650	17%	26%	36%	40%
Baiti	57550	1%	3%	5%	12%
Boe	18075	17%	26%	37%	48%
Buada	212450	0%	0%	0%	0%
Denigomodu	48325	0%	0%	0%	0%
Ewa	60025	6%	15%	21%	30%
Ijuw	75675	18%	27%	43%	53%
Meneng	157925	22%	37%	55%	68%
Nibok	95700	0%	0%	1%	2%
Uaboe	16875	0%	0%	1%	1%
Yaren	35175	12%	19%	35%	50%

Figure 8 West Nauru Coconut crops impacted by coastal inundation relating to 2m Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted crops shown in red, and non-impacted crops shown in green (top). Number of coconut crops and percentage inundated across Nauru (all) and the western districts (gold/green highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

2.3 Electricity Poles

Nauru has almost 800 electricity poles distributed across the Island. These electricity poles are largely located adjacent to the building infrastructure which in turn is concentrated on the coastal areas around the island. For the majority of districts the number of electricity poles is approximately proportional to the length of coastline for each respective District. For the West Districts of Aiwo, Denigomodu and Boe the number of Electricity Poles is more concentrated around the larger built environment areas that extend further from the coast (*Figure 9*).

The Electricity Poles for Nauru are resilient to a 0.5m sea level rise scenario, with only 1% of all electricity poles impacted across the island in the district of Meneng, representing and impact for 4% of all electricity poles for the district (*Figure 9*). Under a Sea Level Rise Scenario of 1m (Figure 13) the percentage of electricity poles impacted increases to 4% with the Districts of Anabar and Meneng increasing to 15% and 16% of poles impacted respectively. At a Sea Level Rise Scenario of 1m the majority of Districts have 0% of poles impacted. At a 1m Sea Level Rise Scenario the Meneng District which has the second largest number of electricity poles has 16% of poles impacted, whilst Aiwo that has the largest number of poles has less than 1% impacted.

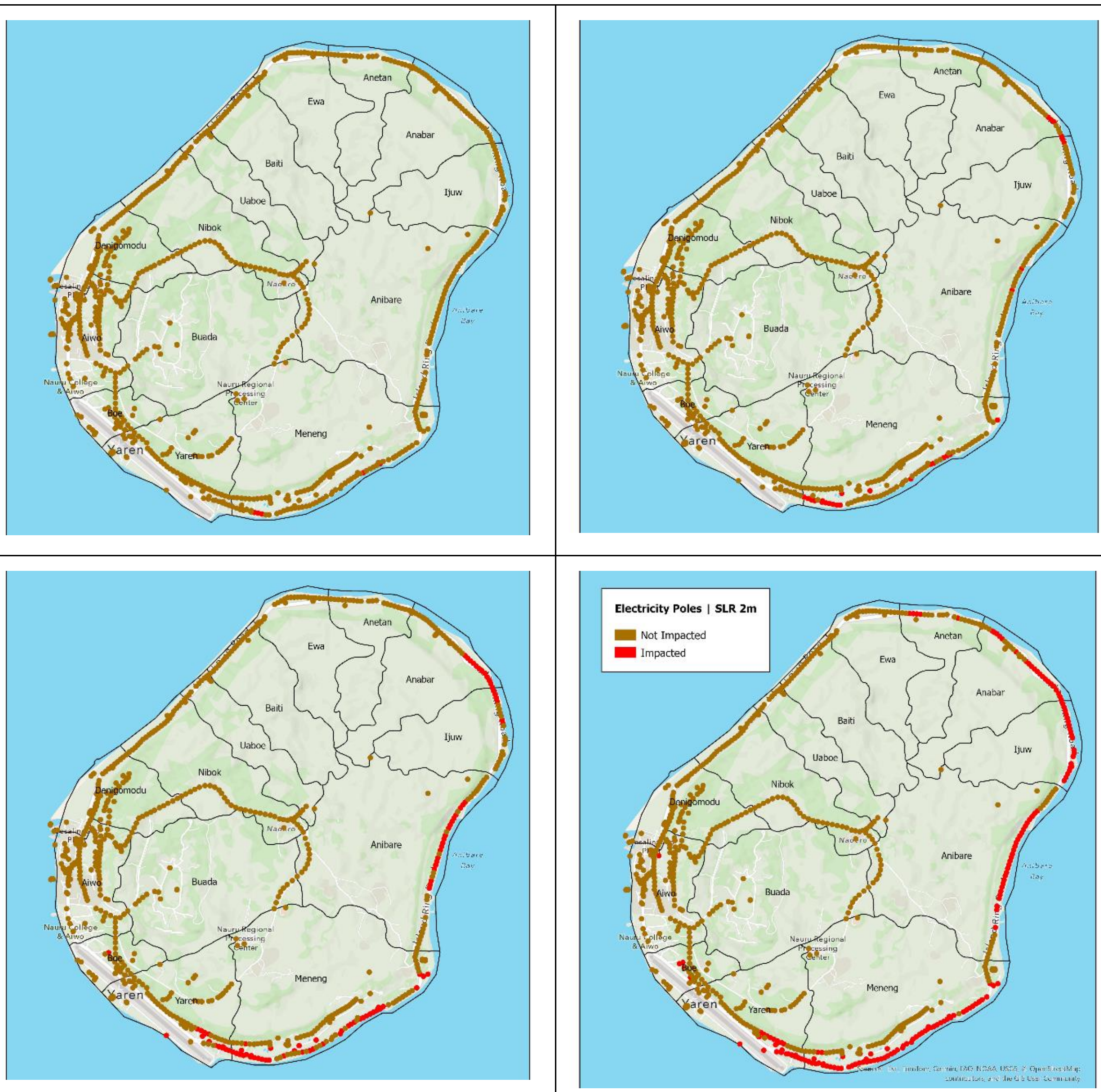
At a 1.5m Sea Level Rise Scenario (*Figure 9*) there is a significant increase in the number of electricity poles impacted across Nauru, with 12% of all poles impacted. The Districts of Anabar, Anibare and Meneng on the east coast all see an increase to around a third of all electricity poles impacted, whilst the District of Ijuw which is also on the east coast jumps from less than 1% under a Sea Level Rise Scenario of 1m to 16% under a Sea Level Rise Scenario of 1.5m.

The District of Yaren on the south coast of Nauru where the airport is located sees an increase in the percentage of poles impacted from under 1 % with a Sea Level Rise Scenario of 1m to 14 % impacted under a Sea Level Rise Scenario of 1.5m (*Figure 9*).

The Sea Level Rise Scenario of 2m seas in increase in the number electricity poles impacted across Nauru to almost a quarter of all poles, with significant impact on the East Coast of the island (*Figure 9*).

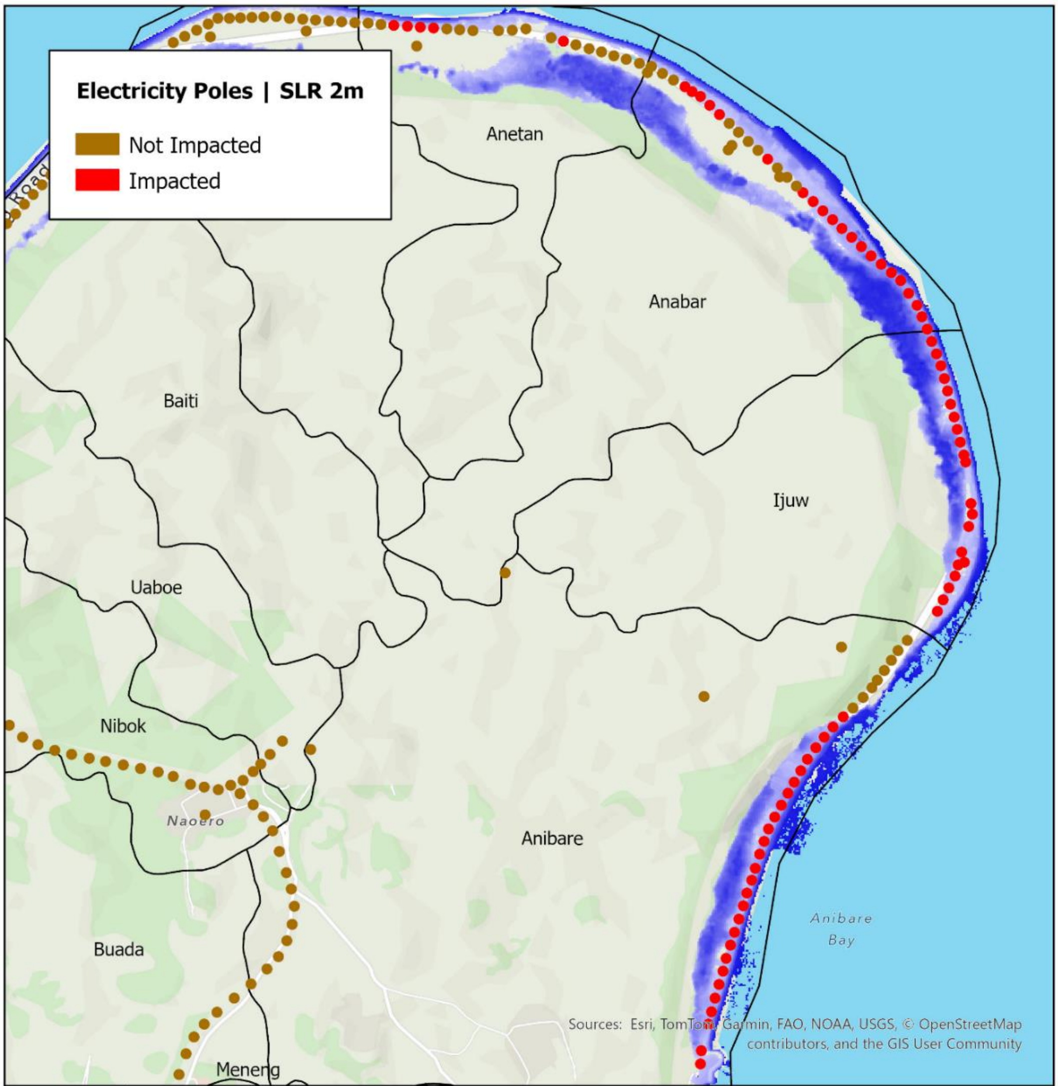
In addition to the East Districts of Anabar and Anabar seeing 62 % and 52 % of electricity poles impacted respectively under a 2m Sea Level Rise Scenario, the District of Ijuw jumps from 16 % of poles impacted under a 1.5m Sea Level Rise Scenario to 95 % of poles impacted by a 2m Sea Level Rise Scenario. Ijuw has the highest number of Electricity Poles Impacted of any District under the 2m Sea Level Rise Scenario (*Figure 9*).

The District of Yaren that has the third most electricity poles of any District sees over a quarter of all poles impacted by a 2m Sea Level Rise Scenario, whilst Meneng which has the second most poles of any District sees over a half of these poles impacted by a 2m Sea Level Rise Scenario. The West District of Aiwo which has the most electricity poles of any District is relatively resilient to the 2m Sea Level Rise Scenario with only 1 % of electricity poles impacted by a 2m Sea Level Rise Scenario (*Figure 9*).



Area	Electricity Poles	Electricity Poles Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	788	1%	4%	12%	22%
Aiwo	147	0%	0%	0%	1%
Anabar	39	0%	15%	38%	62%
Anetan	22	0%	0%	0%	23%
Anibare	56	0%	4%	36%	52%
Baiti	19	0%	0%	0%	0%
Boe	29	0%	0%	3%	14%
Buada	18	0%	0%	0%	0%
Denigomodu	86	0%	0%	0%	0%
Ewa	33	0%	0%	0%	0%
Ijuw	19	0%	0%	16%	95%
Meneng	131	4%	16%	32%	51%
Nibok	61	0%	0%	0%	0%
Uaboe	15	0%	0%	0%	0%
Yaren	98	0%	0%	14%	27%

Figure 9 Nauru Electricity Poles impacted by coastal inundation relating to 0.5m (top left), 1.0m (top right), 1.5 (middle left) and 2m (middle right) Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted electricity poles shown in red, and non-impacted electricity poles shown in brown. Number of electricity poles and percentage inundated across Nauru (all) and the different districts under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Electricity Poles	Electricity Poles Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	788	1%	4%	12%	22%
Aiwo	147	0%	0%	0%	1%
Anabar	39	0%	15%	38%	62%
Anetan	22	0%	0%	0%	23%
Anibare	56	0%	4%	36%	52%
Baiti	19	0%	0%	0%	0%
Boe	29	0%	0%	3%	14%
Buada	18	0%	0%	0%	0%
Denigomodu	86	0%	0%	0%	0%
Ewa	33	0%	0%	0%	0%
Ijuw	19	0%	0%	16%	95%
Meneng	131	4%	16%	32%	51%
Nibok	61	0%	0%	0%	0%
Uaboe	15	0%	0%	0%	0%
Yaren	98	0%	0%	14%	27%

Figure 10 North and East District Electricity Poles Impacted by coastal inundation relating to 2m Sea Level Rise (occurring ~2190 at earliest, see Table 1) with impacted electricity poles shown in red, and non-impacted electricity poles shown in brown (top). Number of electricity poles and percentage inundated across Nauru (all) and the north and eastern districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

2.4 Roads

Nauru Road Infrastructure is distributed through the island, and whilst the Island Ring Road is largely located adjacent to the coastline there is a reasonable level of road infrastructure across the middle of Nauru in areas that will be more resilient to sea level rise.

Under a Sea Level Rise Scenario of 0.5m around 1% of the 72.5km of Nauru Roads are impacted, with the Districts of Anabar and Anetan on the North East coast having 7% and 5% of roads impacted respectively (Figure 16). The District of Meneng which has the largest length of road of any district has 3% of these roads impacted by a Sea Level Rise Scenario of 0.5m. The rest of the Nauru Districts have less than 1% of roads impacted under the 0.5m Sea Level Rise Scenario.

The 1m Sea Level Rise Scenario sees an increase in the percentage of roads impacted across Nauru to 4% compared to the 1 % impacted under the 0.5m Sea Level Rise Scenario (Figure 17). The East Districts of Anabar, Anetan and Meneng that were all impacted at a 0.5m Sea Level Rise Scenario continue to be further impacted under a 1m Sea Level Rise Scenario at 14 %, 12 % and 9 % respectively.

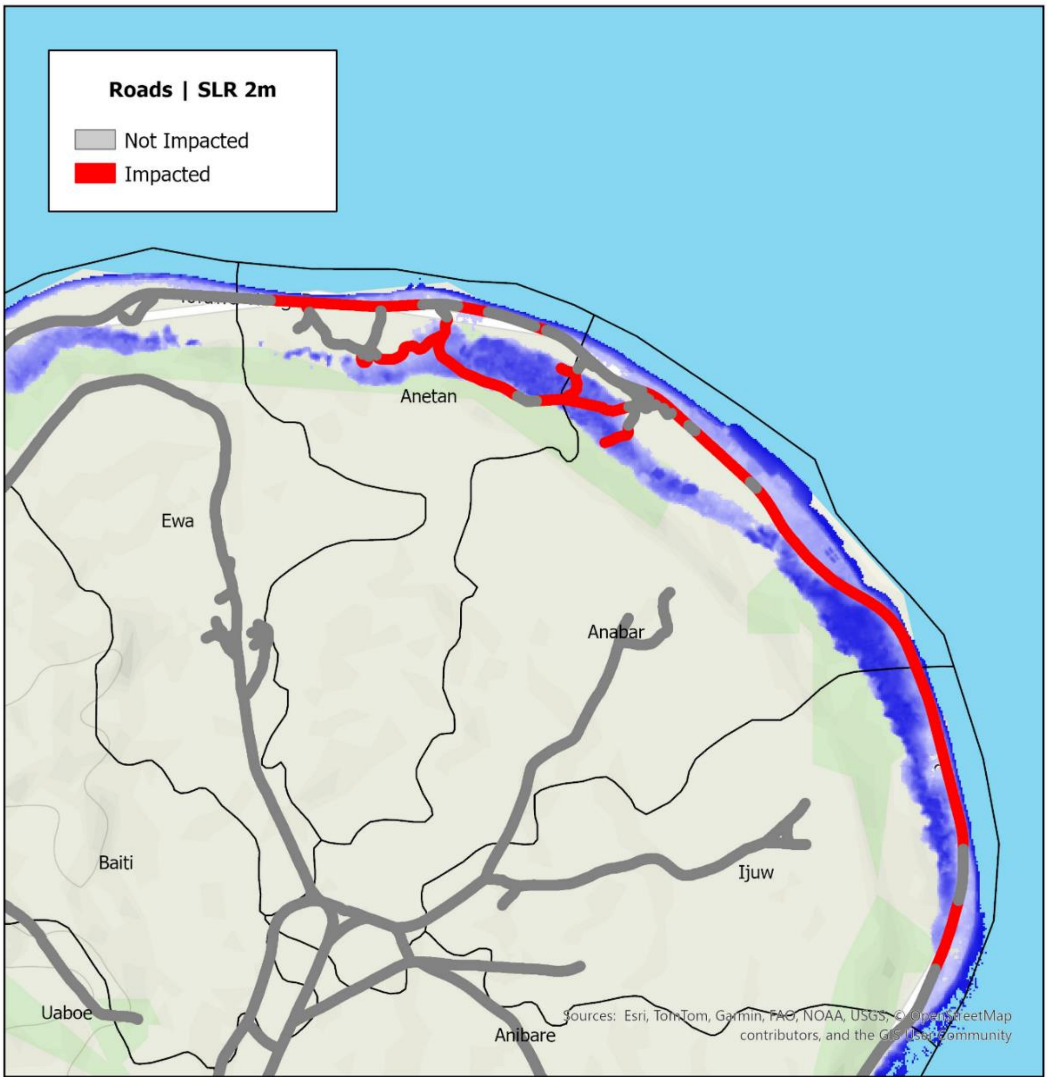
Under a 1.5m Sea Level Rise Scenario the percentage of road impacted doubles to 8 % from 4 % under a 1m Sea Level Rise Scenario (Figure 18). The East Coast Districts of Anabar, Anetan and Meneng see the largest impact with all Districts seeing around 10% of road impacted. The District of Anibare with a significant length of Island Ring Road sees an increase to 10% of road length impacted by the 1.5m Sea Level Rise Scenario. The Districts of Ijuw and Yaren increased to 4% of roads impacted by a 1.5m Sea Level Rise Scenario, both from a base of less than 1% of road impacted by the 1m Sea Level Rise Scenario.

Under the 2m Sea Level Rise Scenario the total length of Road impacted across Nauru increases to 15 % with a strong concentration of impact on roads on the East Coast of the island. West Coast Districts of Aiwo, Boe, Buada and Denigomodu see less than 1 % of roads impacted under the 2m Sea Level Rise Scenario.

Area	Length Roads (km)	Road Length Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	72.5	1%	4%	8%	15%
Aiwo	5.06	0%	0%	0%	0%
Anabar	4.71	7%	14%	21%	38%
Anetan	2.818	5%	12%	18%	49%
Anibare	12.218	0%	3%	10%	13%
Baiti	2.787	0%	0%	0%	1%
Boe	2.067	0%	0%	0%	0%
Buada	4.356	0%	0%	0%	0%
Denigomodu	3.448	0%	0%	0%	0%
Ewa	3.853	0%	0%	0%	0%
Ijuw	3.136	0%	0%	4%	21%
Meneng	14.874	3%	9%	19%	28%
Nibok	2.98	0%	0%	1%	3%
Uaboe	3.351	0%	1%	2%	2%
Yaren	6.853	0%	0%	4%	16%

Figure 11 Nauru roads impacted by coastal inundation relating to 0.5m (top left), 1.0m (top right), 1.5 (middle left) and 2m (middle right) Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted roads shown in red, and non-impacted roads shown in grey. Number of electricity poles and percentage inundated across Nauru (all) and the different districts under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

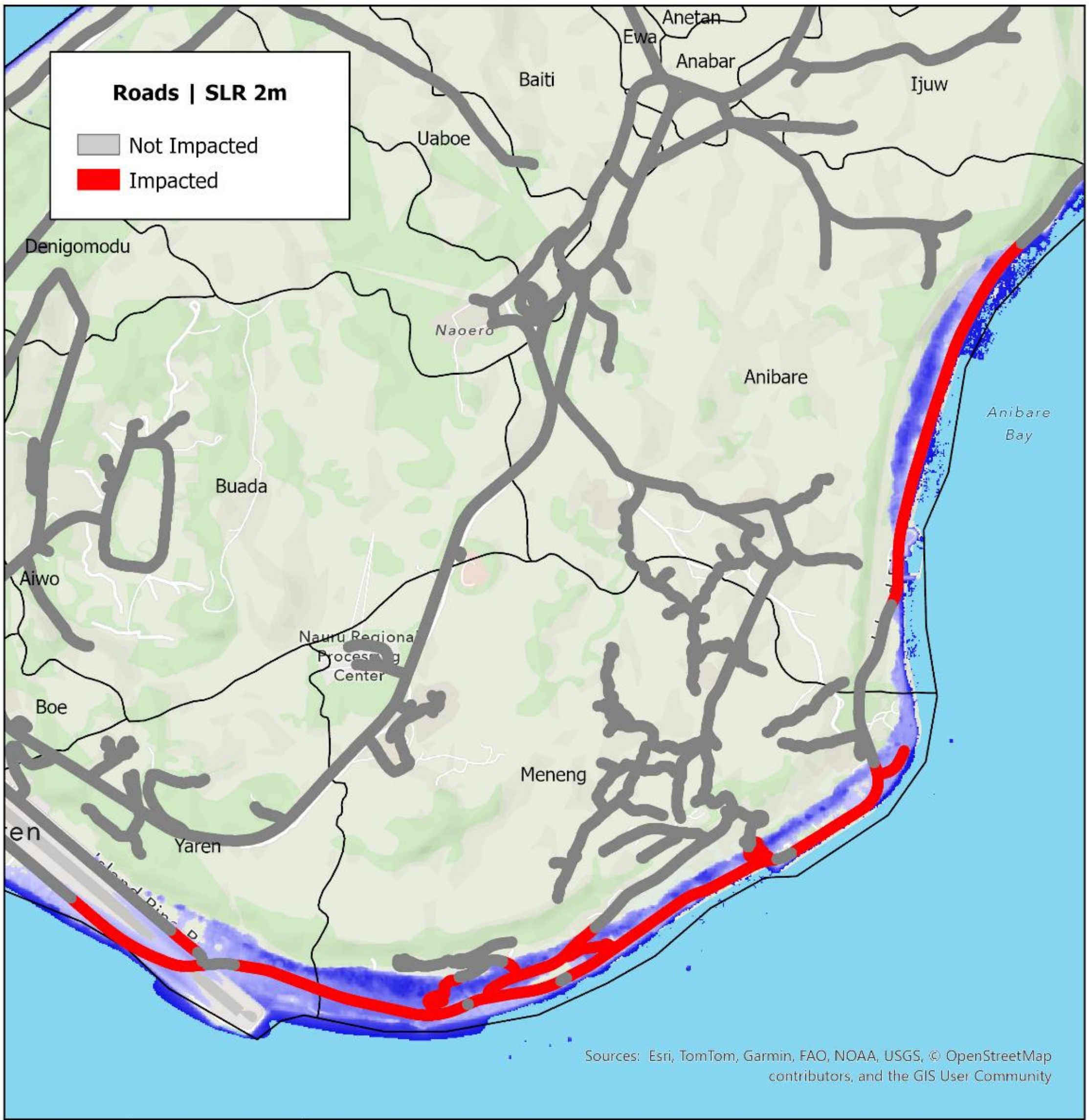
The East Coast Districts of Anabar, Anetan, Meneng and Ijuw have the largest length of road impacted under the 2m Sea Level Rise Scenario (*Figure 12* and *Figure 13*).



Area	Length Roads (km)	Road Length Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	72.5	1%	4%	8%	15%
Aiwo	5.06	0%	0%	0%	0%
Anabar	4.71	7%	14%	21%	38%
Anetan	2.818	5%	12%	18%	49%
Anibare	12.218	0%	3%	10%	13%
Baiti	2.787	0%	0%	0%	1%
Boe	2.067	0%	0%	0%	0%
Buada	4.356	0%	0%	0%	0%
Denigomodu	3.448	0%	0%	0%	0%
Ewa	3.853	0%	0%	0%	0%
Ijuw	3.136	0%	0%	4%	21%
Meneng	14.874	3%	9%	19%	28%
Nibok	2.98	0%	0%	1%	3%
Uaboe	3.351	0%	1%	2%	2%
Yaren	6.853	0%	0%	4%	16%

Figure 12 North Nauru roads impacted by coastal inundation relating to 0.5m (top left), 1.0m (top right), 1.5 (middle left) and 2m (middle right) Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted roads shown in red, and non-impacted roads shown in grey. Number of electricity poles and percentage

inundated across Nauru (all) and the northern districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).



Area	Length Roads (km)	Road Length Impacted (Percentage)			
		0.5m	1m	1.5m	2m
Nauru (all)	72.5	1%	4%	8%	15%
Aiwo	5.06	0%	0%	0%	0%
Anabar	4.71	7%	14%	21%	38%
Anetan	2.818	5%	12%	18%	49%
Anibare	12.218	0%	3%	10%	13%
Baiti	2.787	0%	0%	0%	1%
Boe	2.067	0%	0%	0%	0%
Buada	4.356	0%	0%	0%	0%
Denigomodu	3.448	0%	0%	0%	0%
Ewa	3.853	0%	0%	0%	0%
Ijuw	3.136	0%	0%	4%	21%
Meneng	14.874	3%	9%	19%	28%
Nibok	2.98	0%	0%	1%	3%
Uaboe	3.351	0%	1%	2%	2%
Yaren	6.853	0%	0%	4%	16%

Figure 13 South Nauru roads impacted by coastal inundation relating to 0.5m (top left), 1.0m (top right), 1.5 (middle left) and 2m (middle right) Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted roads shown in red, and non-impacted roads shown in grey. Number of electricity poles and percentage

inundated across Nauru (all) and the northern districts (gold highlight) under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

3 Critical Infrastructure

3.1 Overview

Critical Infrastructure for Nauru (see *Figure 14*) is concentrated in the South of the Island, from the District of Denigomodu on the West Coast to the District of Anibare on the East Coast. There is a cluster of Critical Infrastructure on the South West Coast including the Nauru Fire Station, Parliament House and the Nauru airport.

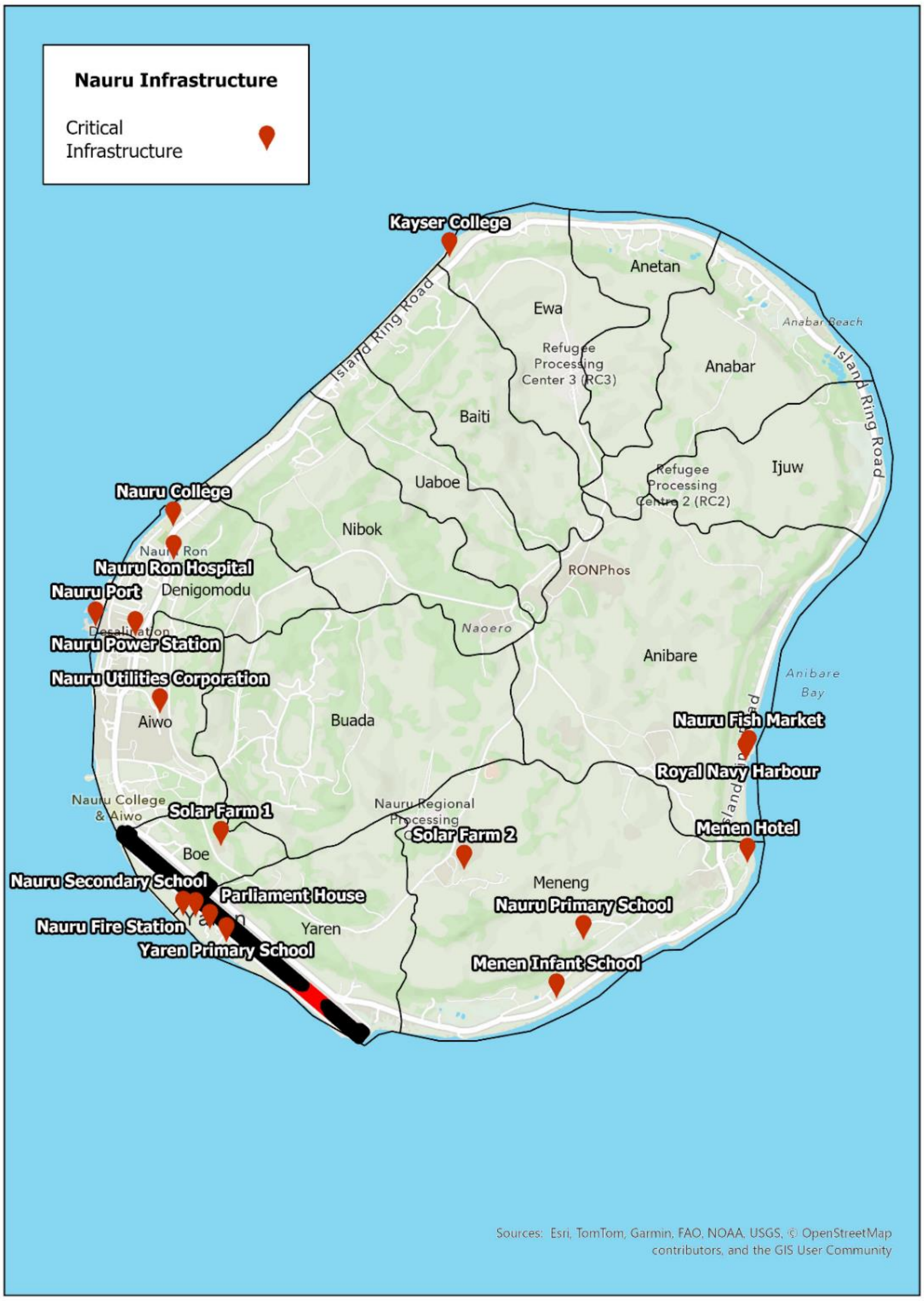


Figure 14 Overview of Nauru Critical Infrastructure.

The extent of sea level rise whereby critical infrastructure is affected is tabulated below (*Table 2*). In this analysis, only the Royal Navy Harbour is impacted at the lowest Sea Level Rise Scenario of 0.5m, although the Nauru Fish Market and Menen Hotel that are also located on the East Coast would be impacted at a Sea Level Rise Scenario of 1m. The Airport, Menen School and Yaren Primary School were all impacted at the maximum 2m Sea Level Rise Scenario. Much of the critical infrastructure located on the West Coast showed resilience to sea level rise with the Hospital, Power Utilities, Fire Station, Secondary School and Parliament House all not impacted at the maximum Sea Level Rise Scenario of 2m.

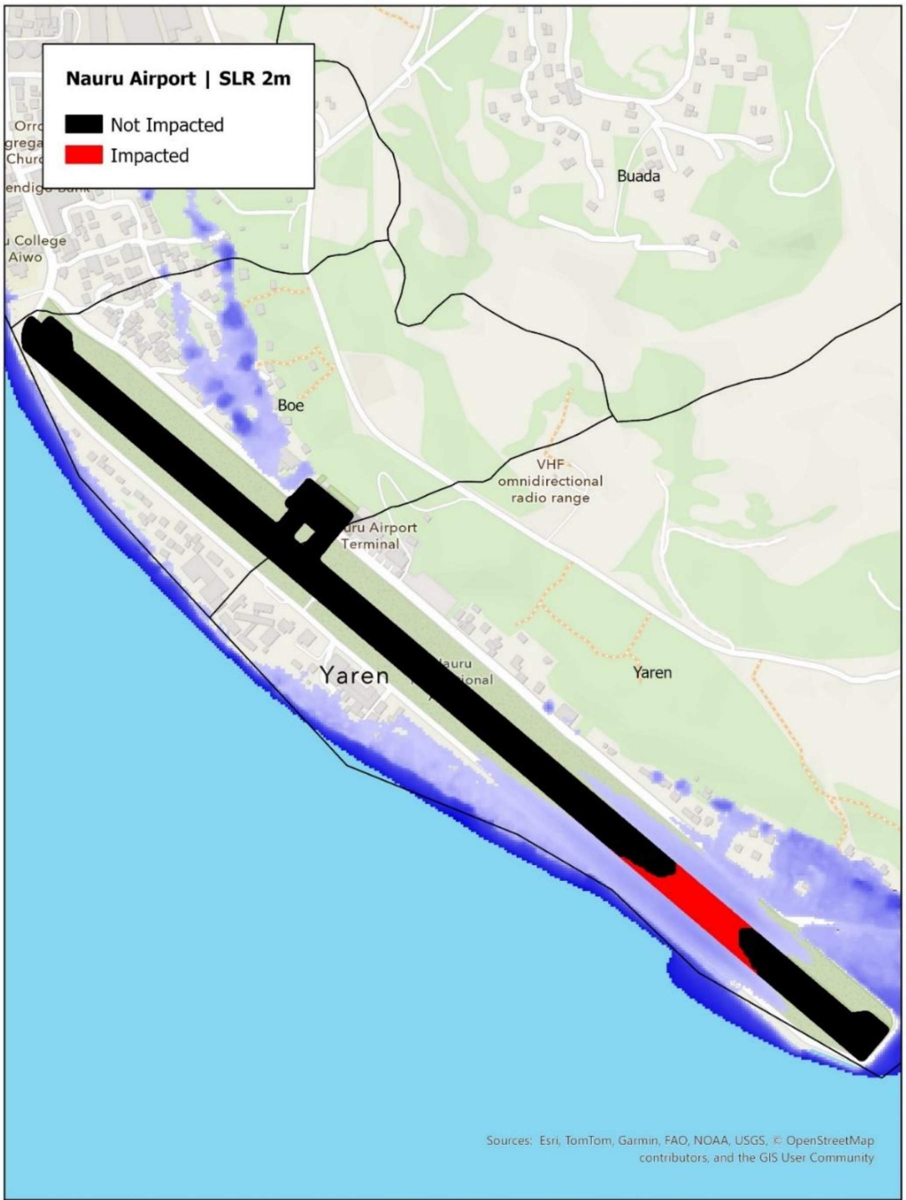
Table 2 Nauru critical infrastructure (see Figure 14) and the SLR incremental level at which it is impacted by coastal inundation.

Nauru Critical Infrastructure	Sea Level Rise Scenario Impact
Airport	2m
Nauru Port	No data *
Hospital	None
Power Utilities	None
Nauru Fish market	1m
Royal Navy Harbour	0.5m
Menen Hotel	1m
Menen School	2m
Fire Station	None
Nauru Secondary School	None
Parliament House	None
Yaren Primary School	2m

* The initial land evaluation dataset for the Nauru port area was obtained from the Pacific Community (SPC) 1 m gridded data from airborne LiDAR topography flown in 2014, prior to the new port works being undertaken. While alternative datasets were explored with regard to coastal inundation mapping, including 2018 Global DEM from Aster, these dataset is still aligned to the previous port structure. For this report we were unable to source data that was sufficiently current relating to the new port structure. Therefore inundation of the current port cannot be accurately represented and exposure mapping has not been included here.

3.2 Airport

The Nauru Airport is located on the South West of the island across the Districts of Boe and Yaren. The Nauru Airport is resilient to Sea Level Rise Scenarios up to 1.5m (*Table 2* and *Figure 15*), with less than 1 % of the airport area impacted. The airport becomes impacted by inundation at the 2m Sea Level Rise Scenario with 10 % of the Airport impacted including the airport runway on the South West corner (*Figure 15*).



Area	Airport Impacted (Percentage)			
	0.5m	1m	1.5m	2m
Airport	0%	0%	0%	10%

Figure 15 Nauru Airport Impacted by 2m Sea Level Rise Scenario Figure 16 Nauru Buildings impacted by coastal inundation relating to 2m of Sea Level Rise (occurring ~2190 at earliest see Table 1) with impacted

part of runway shown in red, and non-impacted shown in black (top). Percentage of airport inundated under 0.5, 1.0, 1.5, and 2.0m of SLR (bottom table).

Figure 17 Airport Infrastructure Sea Level Rise Impact

Figure 18 Airport Infrastructure 0 m Sea Level Rise Impact

Figure 19 Airport Infrastructure 0.5 m Sea Level Rise Impact

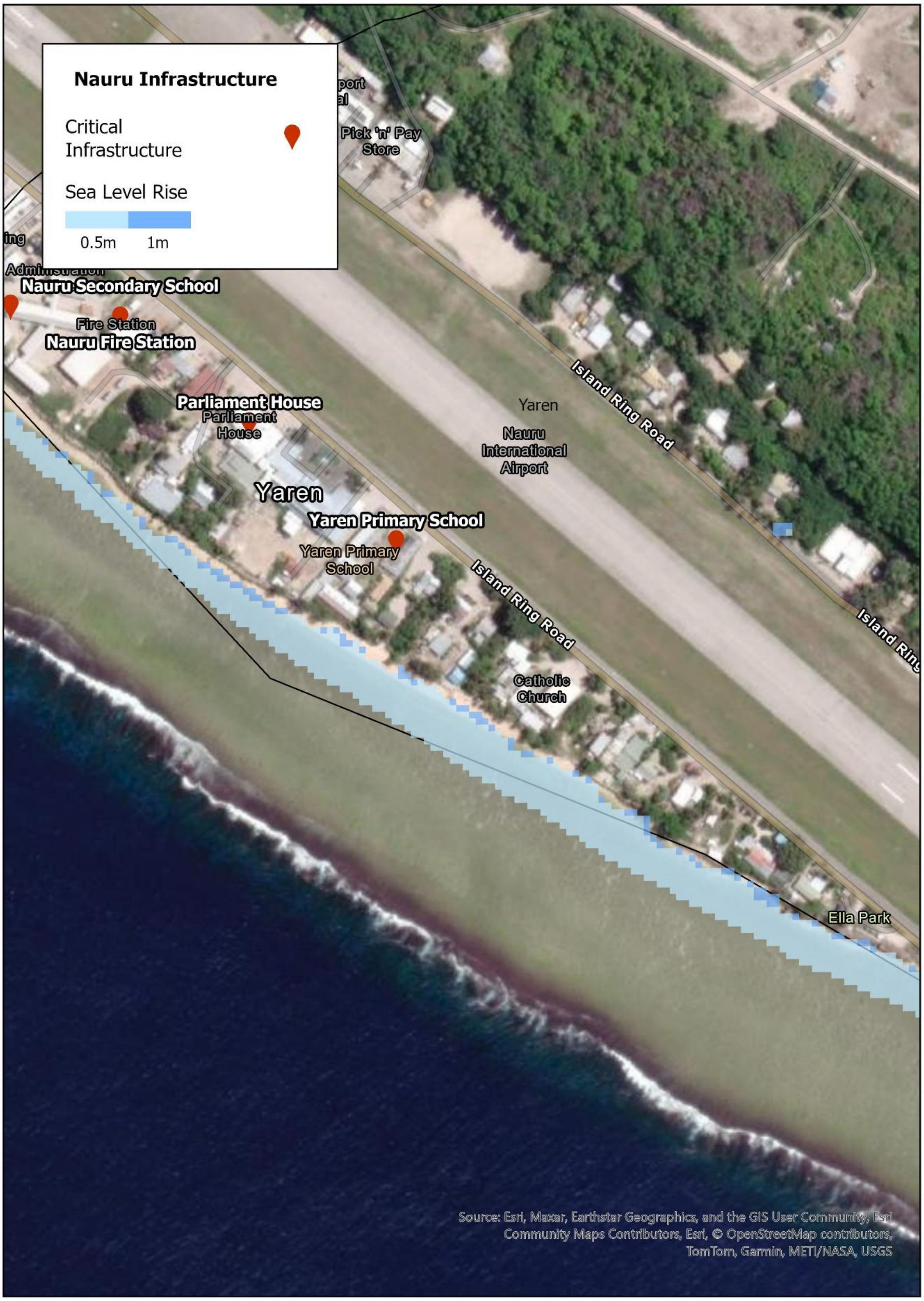


Figure 20 Airport Infrastructure 1.0 m Sea Level Rise Impact

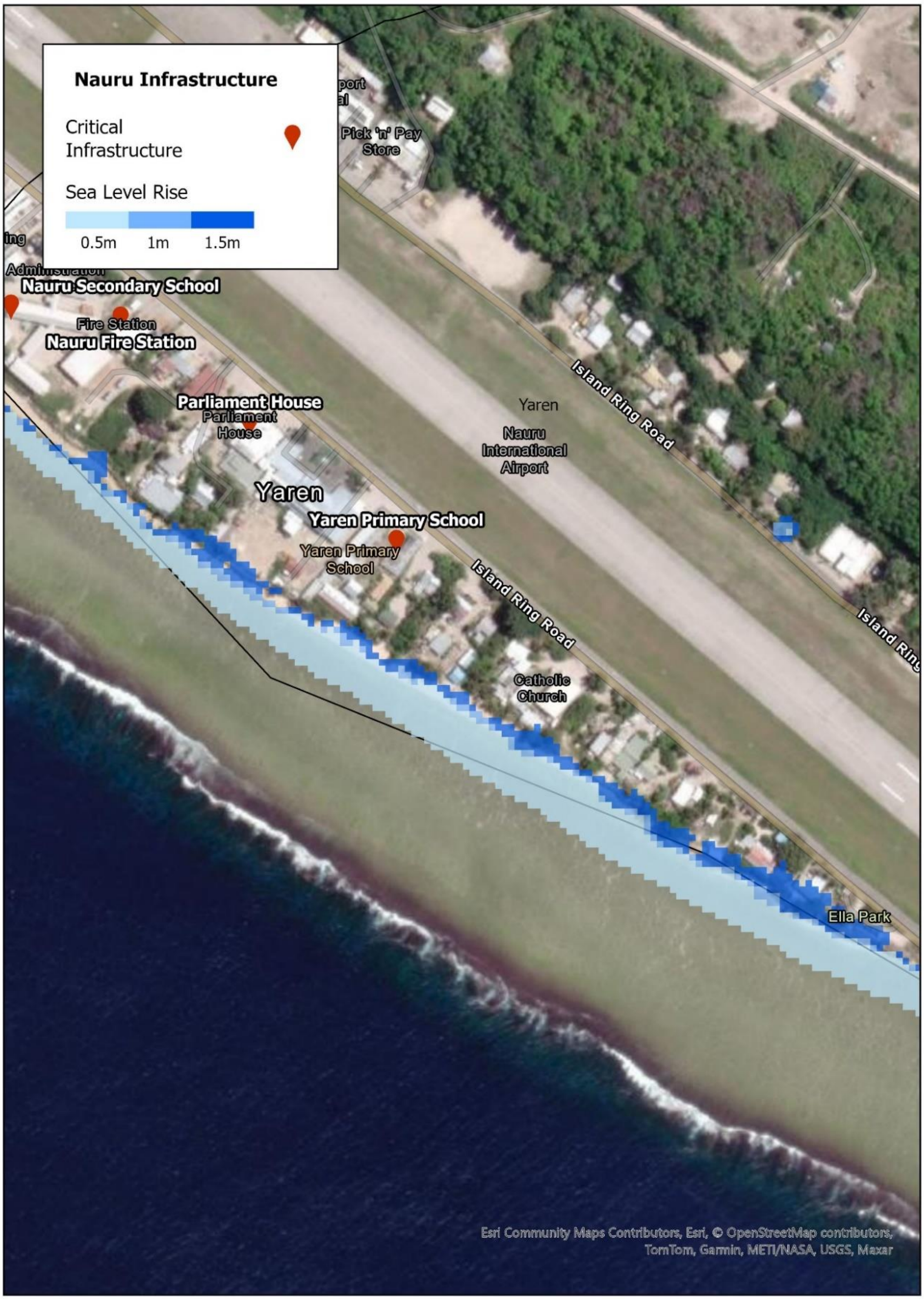


Figure 21 Airport Infrastructure 1.5 m Sea Level Rise Impact

3.3 Other Critical Infrastructure

Of the other infrastructure analysed are noted on *Figure 22* to *Figure 26* images. The infrastructure located on the East Coast is more impacted by Sea Level Rise compared to the infrastructure located on the West Coast, with the infrastructure located on the South Coast in the District of Yaren (*Figure 23*) either marginally impacted or in close proximity to areas impacted by Sea Level Rise Scenarios.

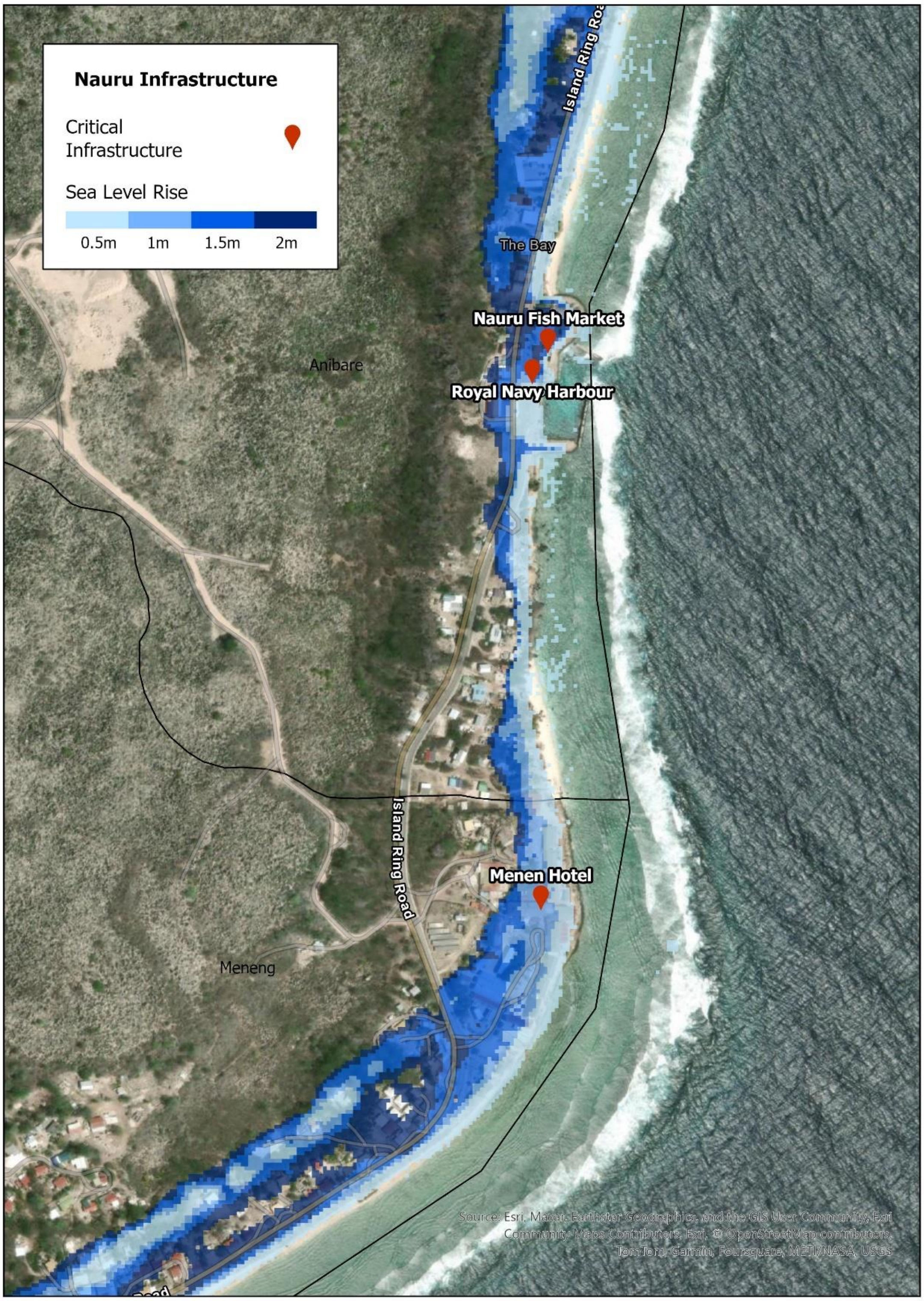


Figure 22 East Coast Critical Infrastructure Impacted by Sea Level Rise of 0.5, 1.0, 1.5, and 2.0 as indicated by the blue shaded areas (see image legend).

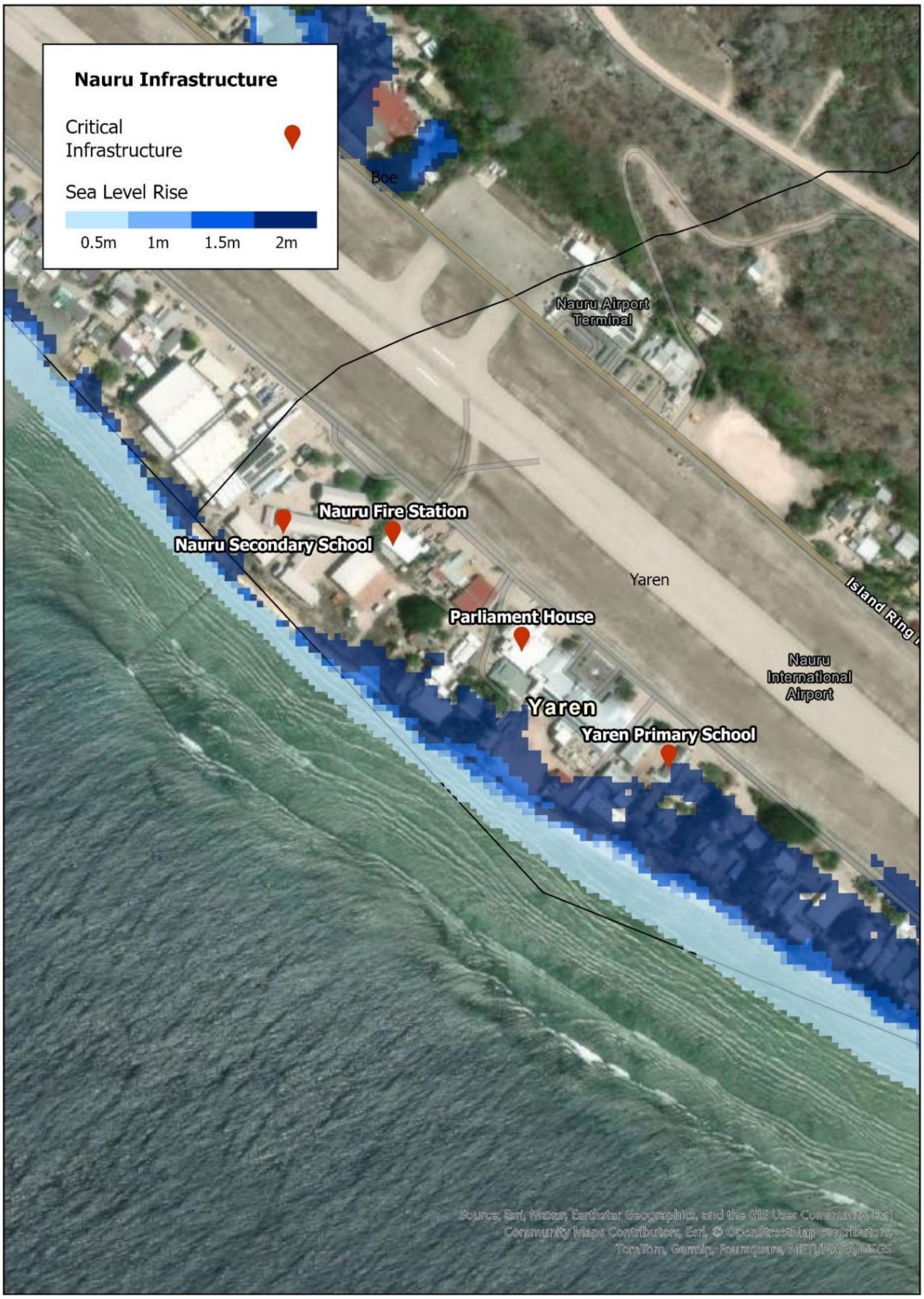


Figure 23 Yaren Critical Infrastructure Impacted by Sea Level Rise of 0.5, 1.0, 1.5, and 2.0 as indicated by the blue shaded areas (see image legend).

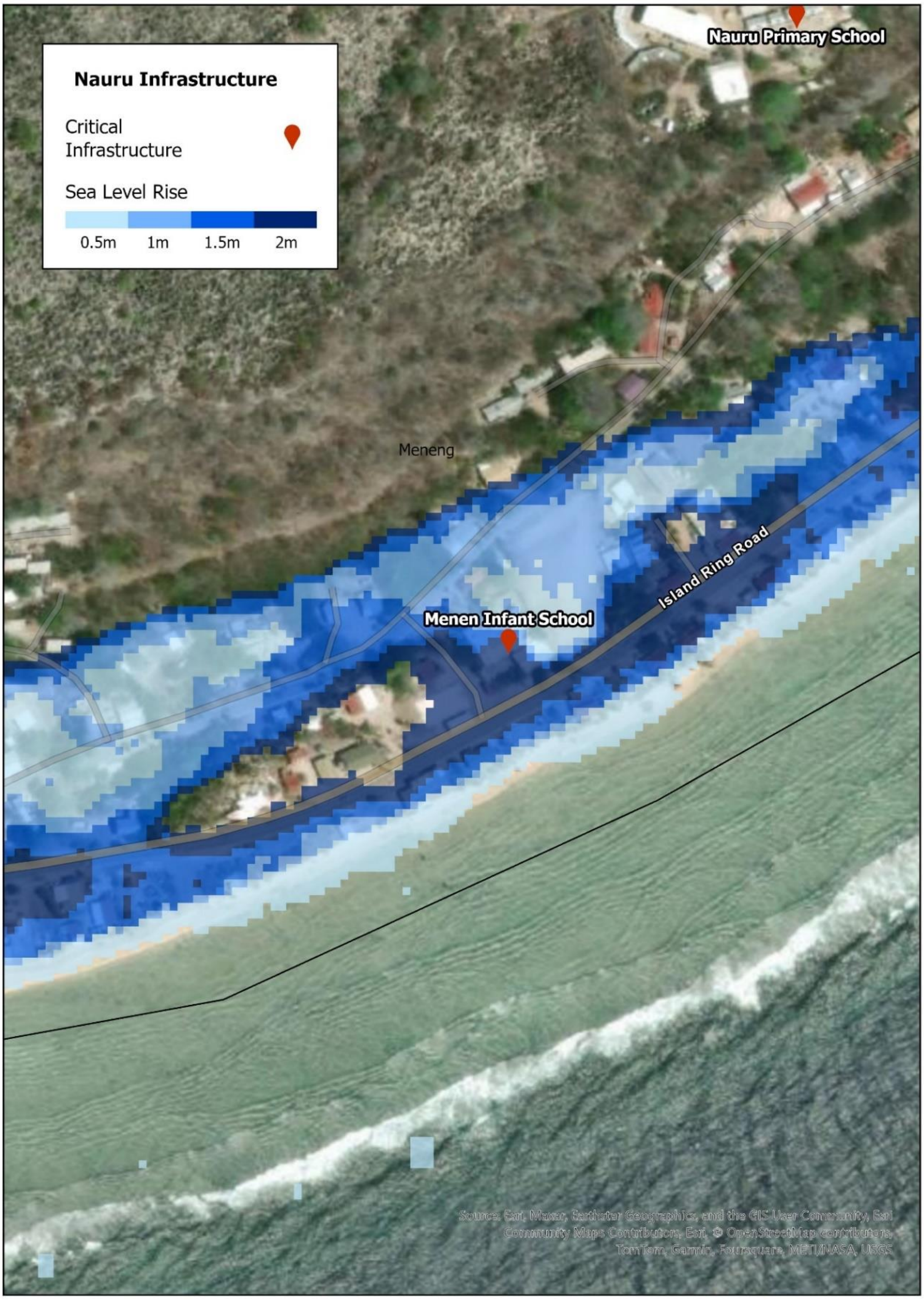


Figure 24 Menen Infant School Impact of Sea Level Rise of 0.5, 1.0, 1.5, and 2.0 as indicated by the blue shaded areas (see image legend).

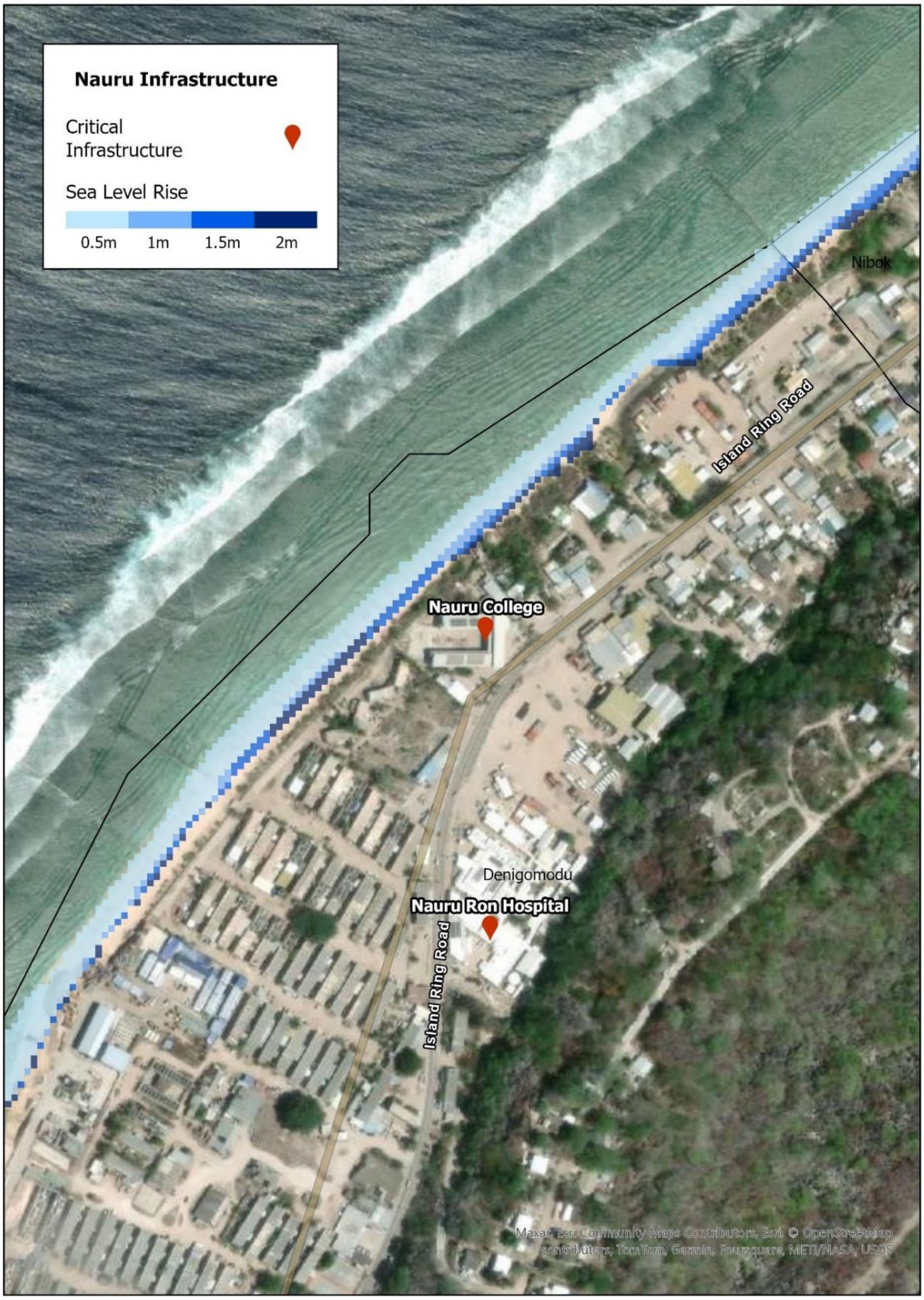


Figure 25 Nauru College and Hospital Sea Level Rise Impact of 0.5, 1.0, 1.5, and 2.0 as indicated by the blue shaded areas (see image legend).

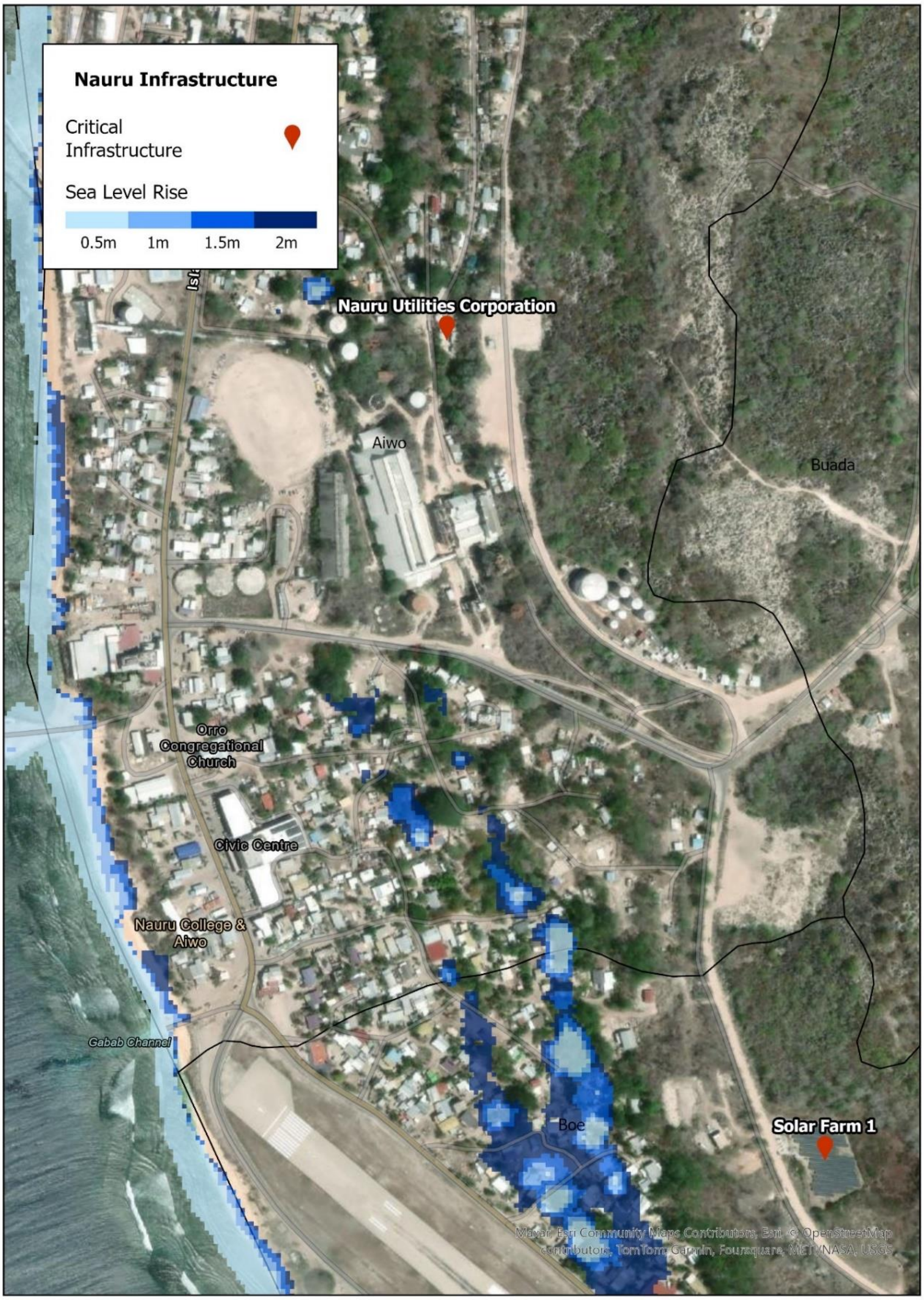


Figure 26 Nauru Utilities Sea Level Rise Impact of 0.5, 1.0, 1.5, and 2.0 as indicated by the blue shaded areas (see image legend).

4 Seawall mapping comparison

The Nauru Seawall and Road Drainage Condition Assessment [4] was commissioned by Department of Infrastructure of the Republic of Nauru (JBP report), and describes the seawall location, make-up and condition.

Inundation maps matching the same maps presented in the JBP Report have been created to indicate the inundation around the seawalls associated with 0.5m, 1.0m, 1.5m, and 2m SLR. NB: High-Resolution files of these inundation maps will be made available to the Nauru Government.

4.1 Seawall CH10 and CH130

Seawall CH10 is located behind the airport runway, spanning 117m in a southwest orientation. Seawall CH130 runs parallel with the airport runway, spanning 155m in a northwest orientation [4]

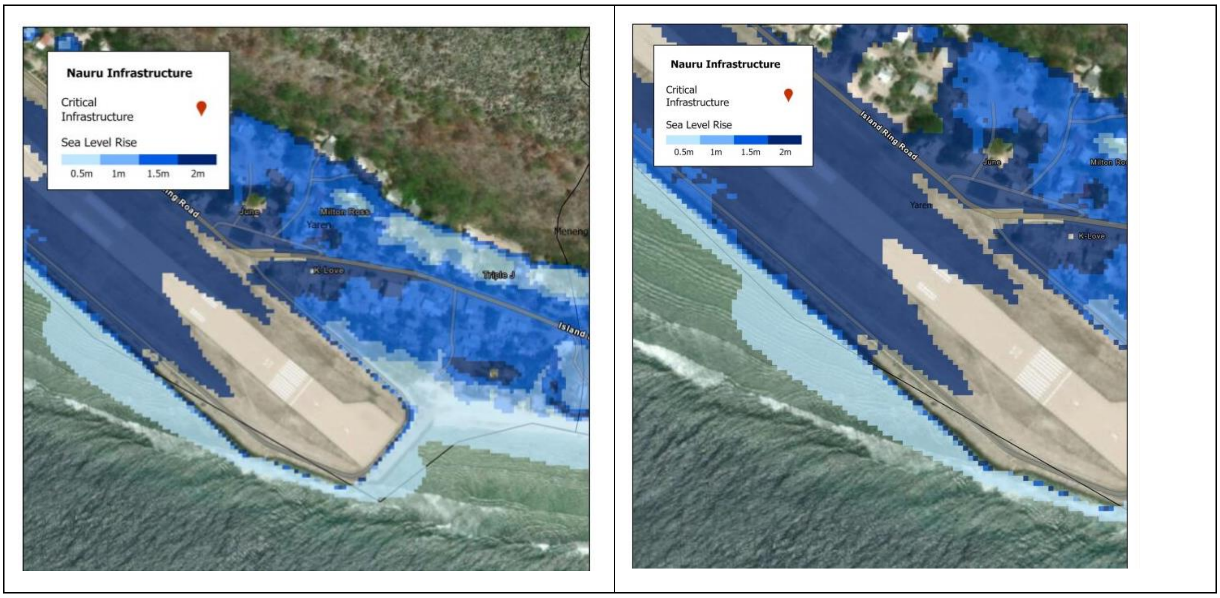


Figure 27 Seawall CH10 and CH130 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH10 and CH130 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.2 Seawall CH280

Seawall CH280 runs parallel with the airport runway, spanning 544m in a northwest orientation [4].

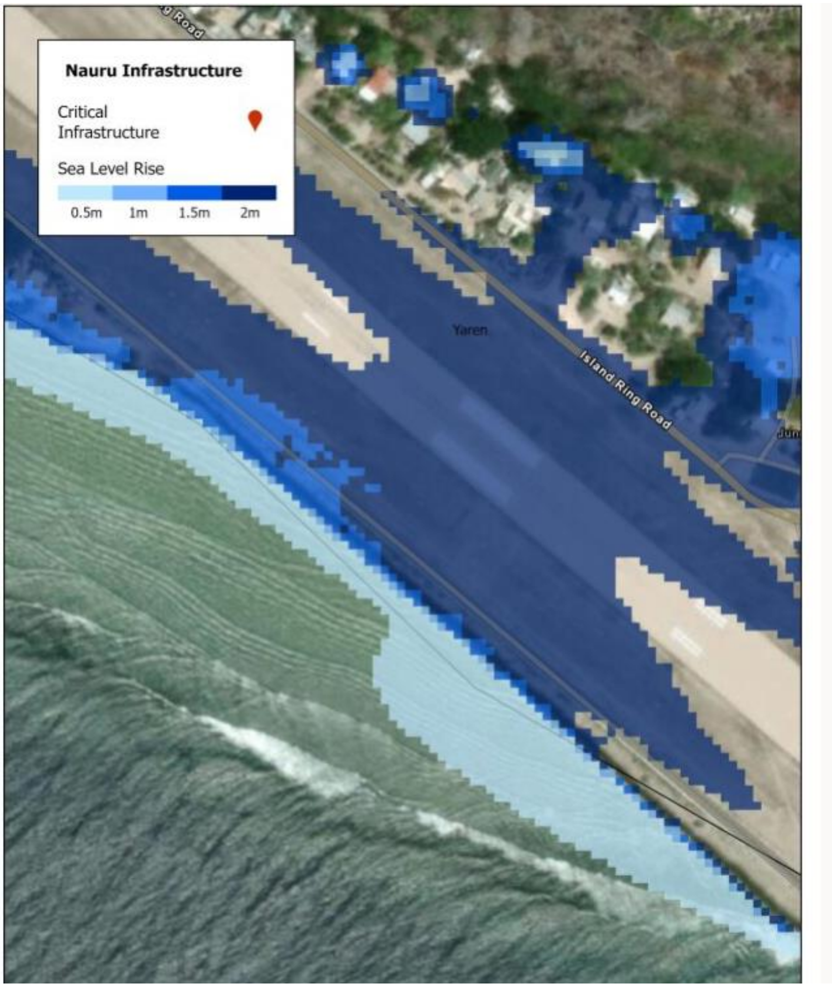


Figure 28 Seawall CH280 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH280 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.3 Seawall CH820

Seawall CH820 is runs generally parallel with the airport runway, spanning 354m in a northwest orientation [4].


Legend
Seawall
280
820
CH820
0 20 40 m
JBP
scientists and engineers

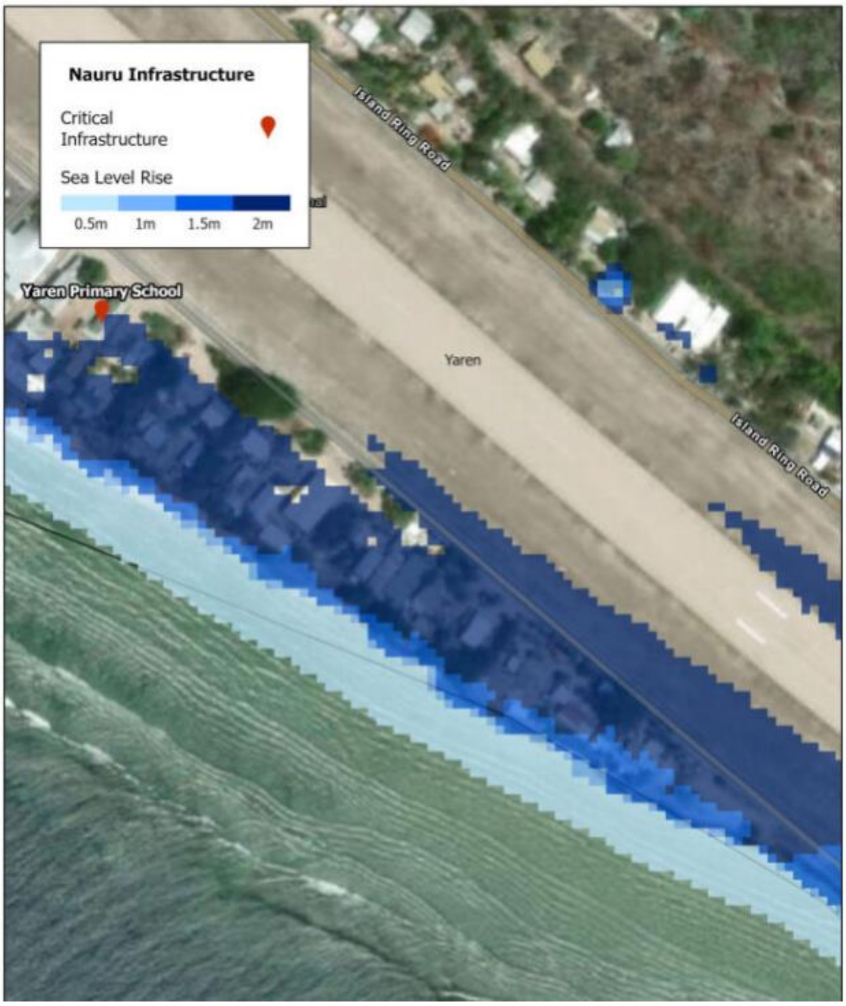

Nauru Infrastructure
Critical Infrastructure
Sea Level Rise
0.5m
1m
1.5m
2m
Island Ring Road
Yaren Primary School
Yaren
Island Ring Road

Figure 29 Seawall CH820 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH820 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.4 Seawall CH1240

Seawall CH1240 runs behind residential dwellings, spanning 899m in a northwest orientation [4].

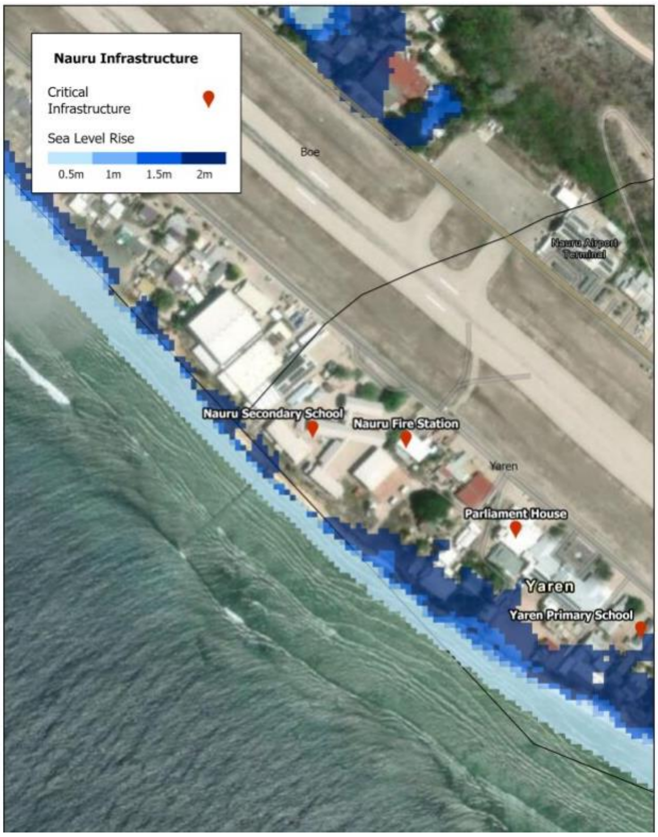


Figure 30 Seawall CH1240 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH1240 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.5 Seawall CH2310, CH2520, CH2830 and CH3060

Seawall CH2310 runs along the ring road, spanning 167m in a northwest orientation. Seawall CH2520 runs between the boat ramp and the breakwater, spanning 117m in a northwest orientation. Seawall CH2830 includes the breakwater and spans 203m around the seaward head. Seawall CH3060 is located immediately behind the Aiwo Hotel and spans 66m in a northerly orientation [4].

Figure 31 Seawall CH2310, CH2520, CH2830 and CH3060 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH2310, CH2520, CH2830 and CH3060 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.6 Seawall CH4310, CH4670 and CH4770

Seawall CH4310 extends around the Nauru port and consists of multiple rock armour and concrete structures, which are still under construction. Seawall CH4670 runs parallel with the Waterfront Road, spanning 83m in a northeast orientation. Seawall CH4770 runs behind residential buildings and a college, spanning 386m in a northeast orientation [4].

Figure 32 Seawall CH4310, CH4670 and CH4770 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH4310, CH4670 and CH4770 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

4.7 SeawallCH5340

Seawall CH5340 protects an industrial open space, spanning 88m in a northeast orientation [4].

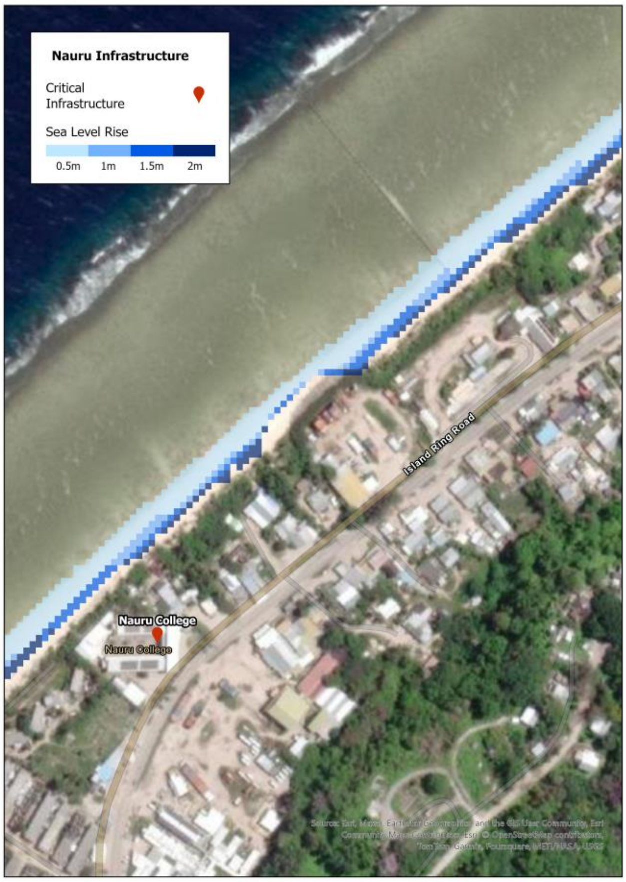


Figure 33 Seawall CH5340 with the location indicated by the red box in the inset map [4] (top) and corresponding coastal inundation map CH5340 (bottom) showing areas inundated by 0.5, 1.0, 1.5 and 2.0 m SLR (shades of blue; see legend).

5 Shoreline Dynamics

Shoreline dynamics have been assessed during the period 1992 to 2020 [5]. Some areas have been gaining mass, or accreting (59 %), while others have been eroding (41 %). Major shoreline erosion was noted around the southern tip of the island at the edge of the airport, with an erosion rate of 0.73 m/year. A closer look at the data indicates that there was a high erosion event between 1992 and 2005, after which the shoreline stabilised (*Figure 34*). Shoreline changes between 1992 and 2005 are likely a result of the airport extension (completed in the early 1990s) [5]. Shoreline accretion (Transect 291) is linked to the reclamation of land for the construction of a new port (*Figure 34*).

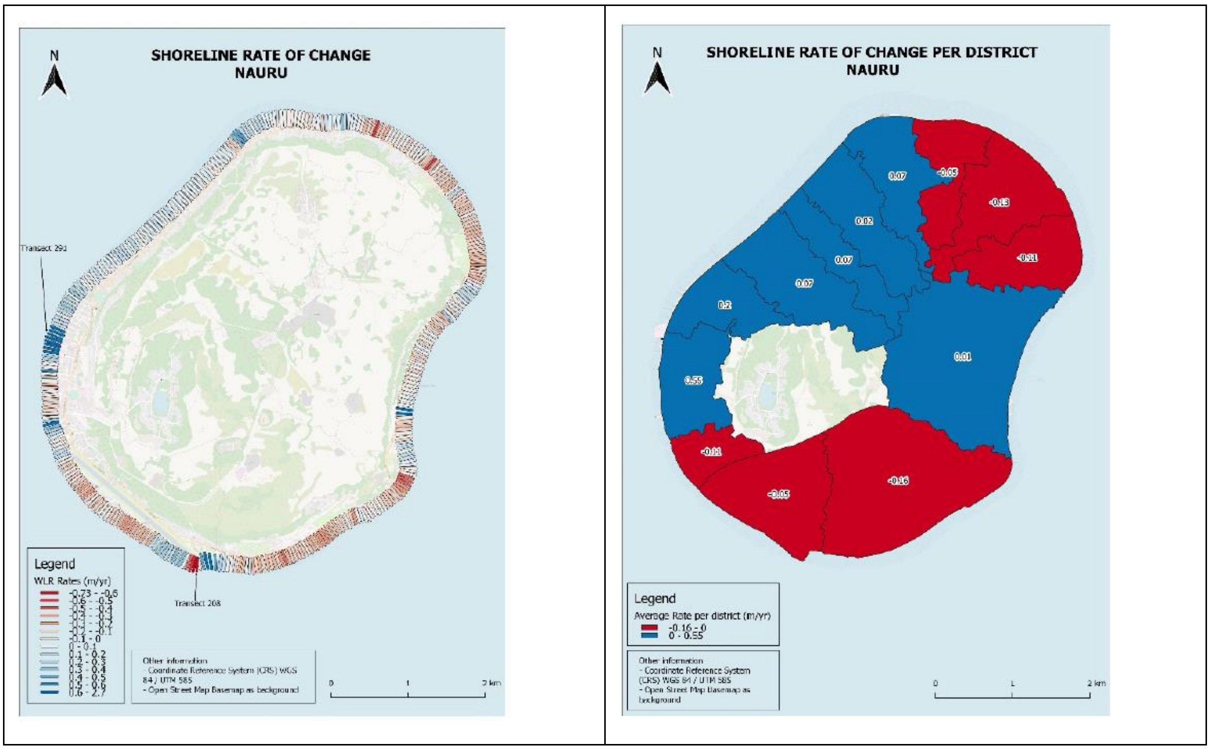


Figure 34 Transects showing weighted linear regression rates for Nauru. Blue indicates areas of accretion, while red indicates areas of erosion. Transects 291 and 208, which are labelled, show the largest accretion and erosion, respectively (left) and the average rate of change for each coastal district in Nauru (right) [5].

6 Caveats, data limitations and recommendations for future improvement

As will all data analysis, the outputs are subject to inherent uncertainties associated with the input datasets used and where required, assumptions made:

- There are significant uncertainties about sea level rise and coastal inundation. The most relevant sea-level tipping point for Nauru is extremely high sea level rise due to rapid ice sheet disintegration (e.g. A predictive sea level rise model (including a correlation between global mean surface temperature and Antarctic ice-mass loss, and a projection of global mean surface temperature for a high (RCP8.5) greenhouse gas concentration pathway), projects a median SLR of 1.84 m, and a 95th percentile value of 2.92 m, by the year 2100 relative to the year 2000) [6, 7], but there is high uncertainty about whether, and on what time scale, such changes will occur. For more detailed information please see Caveats section of the Coastal Inundation Chapter 9 of the Nauru CIVRA Climate Hazards report and the CSIRO workshop report (2024) [8].
- Wave inundation is derived from a single set of wave height and storm tide. This is assumed to be representative of present-day wave inundation hazard. However other scenarios will show different level of exposure and extreme event will occur with lower/ higher waves and lower/ higher storm tide producing different inundation.
- The seamless DEM includes inherent error from the data collection, the bias corrections and interpolation where no data existed. In addition, roughness information was not extracted from the LiDAR/ point cloud information.
- Roughness due to the pinnacle is assumed to behave in similar way as other parts of the reef flat. This is likely a conservative view as the sharp tall pinnacle reef will likely be more efficient at dampening wave transportation and hence, run-up and over-washing processes.
- The buildings layer was updated remotely using satellite imagery and has not been 'ground-truthed' by way of in-country surveys.
- The roads layer used represents the centre of the road and does not represent road edges that may potentially be exposed.
- The coconut crops layer is extracted from a dataset created in 2000 with no further modification/ ground truthing. Future studies should consider updating the crops layer to provide more representative results.
- The poles data used was created in 2000 with no future validation/ ground truthing. Future studies should consider validating/ updating the poles dataset.
- The tanks data did not contain attribute characteristics describing the tank type and/ or elevation above ground level. Further studies should consider ground-truthing and updating the tank dataset.
- Lagoon level elevation is equal to the coastal sea-level elevation, Buada Lagoon was excluded from this analysis.

7 References

1. Bosserelle, C. and S. Williams, *Coastal flooding from sea-level rise in Nauru: Stage 2 - wave inundation mapping, Prepared for the Nauru Higher Ground Project*. 2023 Prepared for: New Zealand Ministry of Foreign Affairs and Trade The Government of the Republic of Nauru, and Calibre Group Limited: Christchurch, NZ.

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3. IPCC, *The ocean and cryosphere in a changing climate*. 2019; Available from: https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/.

4. JBA Pacific Scientists and Engineers, *Nauru Seawall and Road Drainage Condition Assessment: Final Report Appendices*. 2023 Department of Infrastructure, Government of Nauru: Qld, Australia.

5. Wandres, M., J. Giblin, A. Espejo, T. Sovea, R. Simpson, N. Jackson, A.C. Pickering, and H. Damlamian, *Nauru coastal risk assessment*. 2023 Pacific Community (SPC): Suva, Fiji.

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