Cook Is Coastal Calculator

Mangaia
Harbour
Cook Islands




2005 Cyclone Mena

PACIFIC ADAPTATION TO CLIMATE CHANGE
www.sprep.org/climate_change/pacc
SPREP Secretariat of the Pacific Regional Environment Programme
UNDP
Australian AID
gef
With support from UNITAR C3D+ Programme

Coastal Calculator, Purpose

Its main use to assist climate change risk assessments

- **Climate Proofing land and development planning**
  - **Assessing areas at potential risk from inundation**
  - **Setting Coastal Hazards & set-back lines**
  - **Setting minimum ground or floor levels for development**
  - **Establish extent of existing building inundation risk**

- **Coastal Engineering**
  - **Derive coastal structure design**
  - **Accessing adequacy of the design of coastal structures**
  - **Basic coastal engineering profile design optimization**
  - **Basic assessment of how overtopping of existing coastal defence structures may change & how this relates to dangerous overtopping limits**

Input data

1. Select conditions

Island: Mangaia

Select wave conditions: Cyclone conditions

Select ENSO State: All conditions

2. Reef flat characteristics HELP

Width of the reef flat: 134.46 m

Enter reef crest and landward levels

Level of landward edge of reef: 0.10 m relative to MSL

Reef crest level: 0.31 m relative to MSL

Level of the top of any beachrock: -0.50 m relative to MSL

Wave breaking location: Reef edge & rim - Default

Angle of reef face slope (1 in x): 1 in 3 - Default

Reef flat characteristics:

75%-100% smooth rock or coral pavement

3. Shoreline / seawall characteristics HELP

Shoreline type: Sloping (revetment) seawall

Revetment crest level: 4.17 m relative to MSL

Average revetment slope (1 in x): 4.33

Revetment crest width: 0 m

Seawall (revetment) armouring: Smooth concrete

Revetment crest wall: Yes

Results fo Mangaia

Timeframe: 2090s (2090-2099)
Emission Scenario: A1FI

Baseline (present) year: 1980-1999 average (IPCC AR4)
Sea-level rise magnitude: 0.79 m

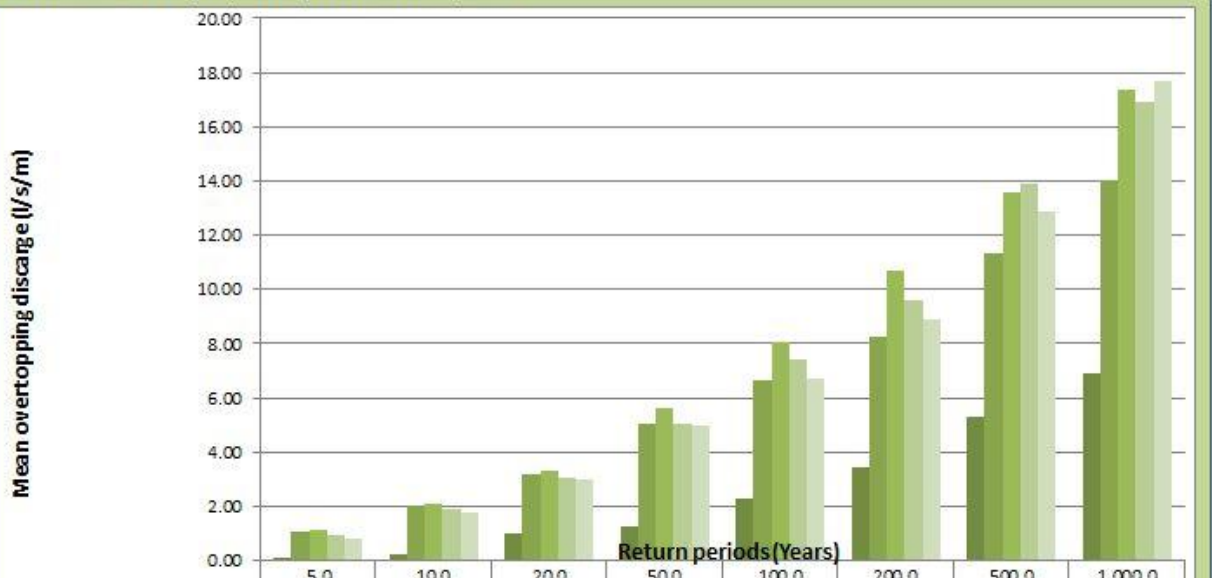
Select results to show: Changes in mean overtopping discharge

Show results in terms of: Return periods (Years)

Compare to overtopping safe limits for:

Changes in mean overtopping discharge

Maximum values from all joint probability conditions for cyclones



	5.0	10.0	20.0	50.0	100.0	200.0	500.0	1,000.0
Present	0.06	0.20	0.98	1.28	2.27	3.42	5.30	6.92
2090s SLR	1.05	2.04	3.18	5.01	6.65	8.26	11.33	14.04
2090s SLR +10%Int 0% Nu	1.11	2.07	3.28	5.63	8.06	10.71	13.60	17.37
2090s SLR +10%Int -10% Nu	0.95	1.88	3.04	5.06	7.40	9.60	13.89	16.91
2090s SLR +20%Int -20% Nu	0.82	1.76	2.99	4.99	6.72	8.91	12.88	17.66

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Input data

1. Select conditions

Island: Mangaia

Select wave conditions: Cyclone conditions

Select ENSO State: All conditions

2. Reef flat characteristics HELP

Width of the reef flat: 150 m

Enter reef crest and landward levels

Level of landward edge of reef: 0.30 m relative to MLoS

Reef crest level: 0.17 m relative to MLoS

Level of the top of any beachrock: -0.50 m relative to MLoS

Wave breaking location: Reef edge & rim - Default

Angle of reef face slope (1 in x): 1 in 3 - Default

Reef flat characteristics:

75%-100% smooth rock or coral pavement

3. Shoreline / seawall characteristics HELP

Shoreline type: Sloping (revetment) seawall

Revetment crest level: 6 m relative to MLoS

Average revetment slope (1 in x): 1

Revetment crest width: m

Seawall (revetment) armouring: Smooth concrete blocks

Revetment crest wall: Yes

Results for Mangaia

Timeframe: 2060s (2060-2069)
Emission Scenario: A1FI
Datum: Mean Level of the Sea (Dec-10 to Feb-11)

Baseline (present) year: 2010
Sea-level rise magnitude: 0.42 m

Select results to show: Changes in mean overtopping discharge

Show results in terms of:

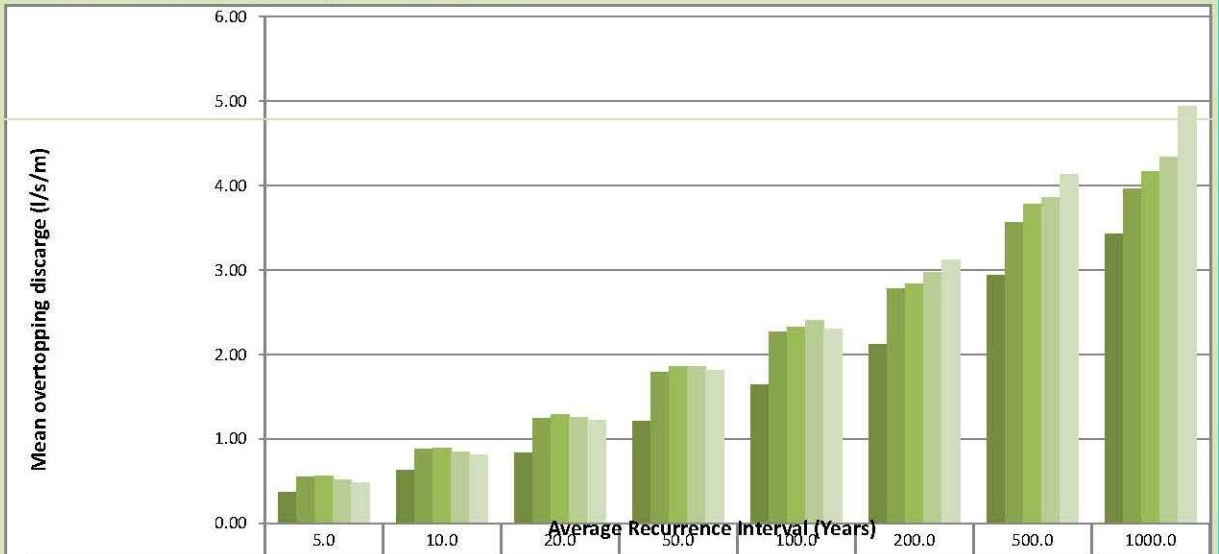
Average Recurrence Interval (Years)

Danger to vehicles (low speed)

Safe overtopping limits = 30-50 litres/s/m

Changes in mean overtopping discharge

Maximum values from all joint probability conditions for cyclones



	5.0	10.0	20.0	50.0	100.0	200.0	500.0	1000.0
Present	0.37	0.63	0.84	1.21	1.64	2.12	2.94	3.42
2060s SLR	0.54	0.88	1.25	1.79	2.26	2.78	3.56	3.96
2060s SLR +10%Int 0% Nu	0.56	0.90	1.29	1.85	2.32	2.83	3.78	4.17
2060s SLR +10%Int -10% Nu	0.52	0.85	1.25	1.85	2.40	2.97	3.86	4.34
2060s SLR +20%Int -20% Nu	0.48	0.81	1.22	1.81	2.31	3.12	4.13	4.93

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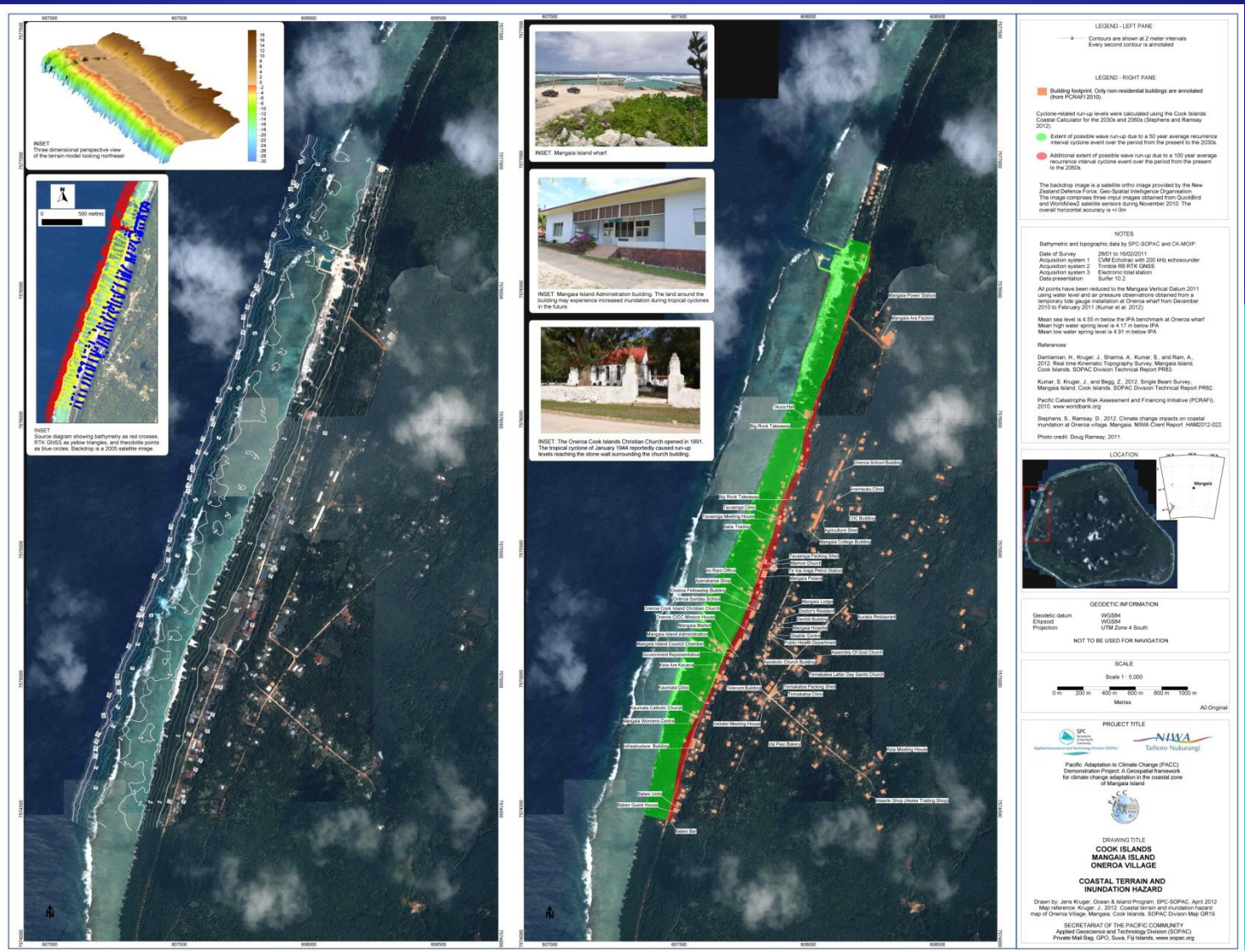
Coastal Terrain & Inundation Hazard Map



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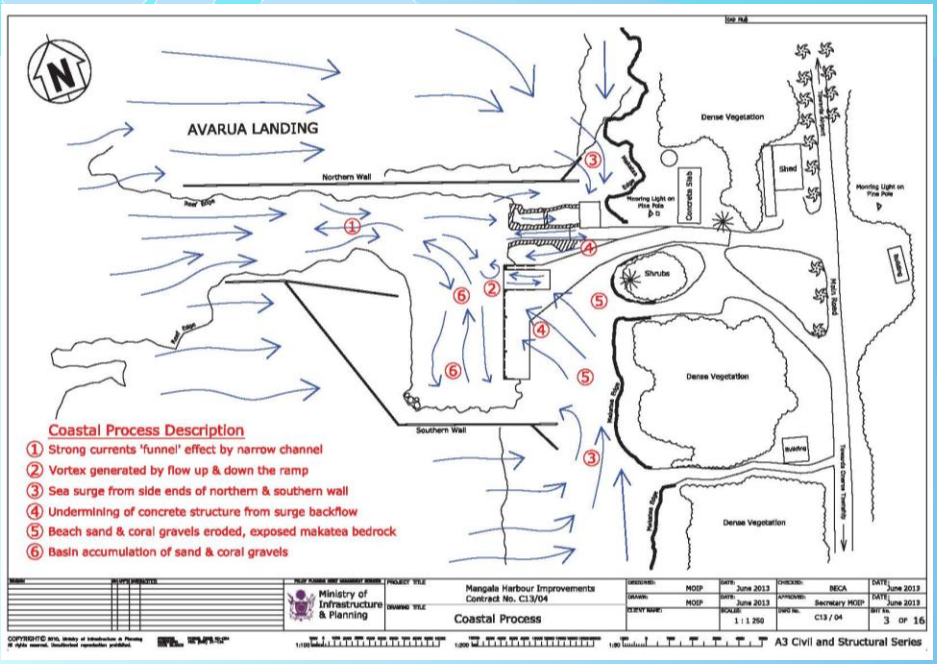
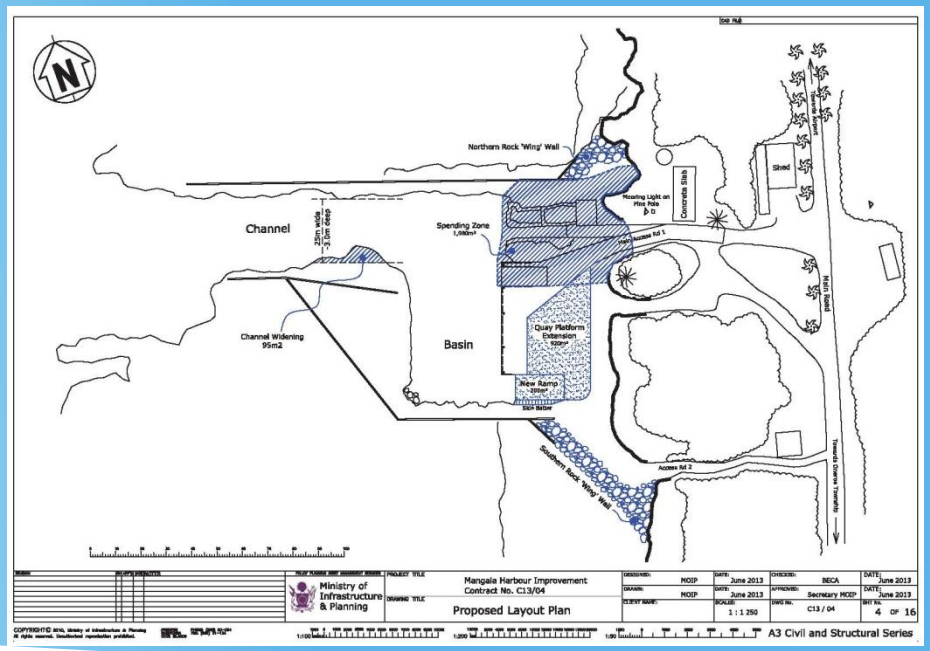
Coastal Engineering – Harbour Strengthening



Present wave action at the Harbour

Main Risks

1. Storm surge / wave run-up
2. Sea Level Rise



IMPLEMENTATION OPTIONS

- Channel widen & deepen
- Spending zone
- Platform Extension
- Ramp relocation
- Raised rockwall (north & south)


Widen Channel 30m
Relocate New Ramp
Concrete Seawall
Spending Zone
Quay Platform Extension
Concrete Seawall

Climate Science & Traditional Knowledge

Challengers

1. Coastal Calculator took 2 years to develop & very expensive
2. Too technical difficult to translate to Cook Is Maori language
3. Effectiveness of the climate proof design, long term beyond project life

What would we do different, if we did the same project again……..

"Wider the scoop of study"

- Incorporate other tools like Rainfall Calculator
- Undertake physical model assessment
- Address flooding as well as coastal impacts