# Breakwater - South Australia (circa 1905)

The History Trust of South Australia

# Port of Mackay (1938)

Cyclone damage to the harbour breakwater at Mackay, 1938

# Port of Mackay (2020)

# Port of Mackay after Cyclone Ului (2010)

ABC (2010)

28 August 2024

# Upgrade, Reinstate, or Retreat? A Comparison of Breakwater Asset Management Strategies

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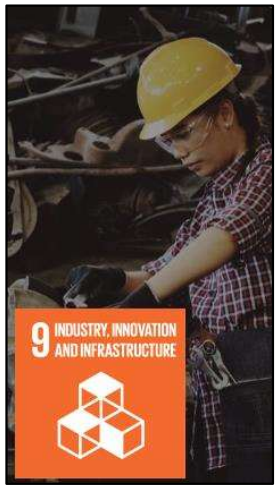
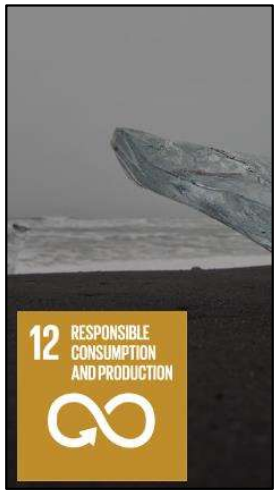
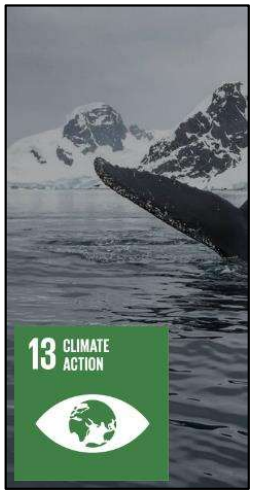
# Objectives

- **High-level** assessment of maintenance strategies (what to do after damage)
- **Cast a wide net** to identify which strategies are feasible and worth further investigation
- Reporting to assist NQBP in developing a **business case** for alternative strategies

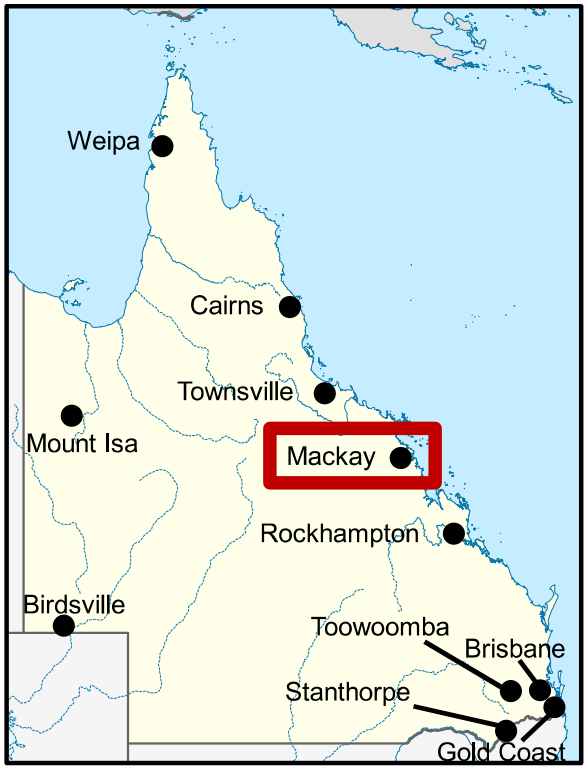
United Nations



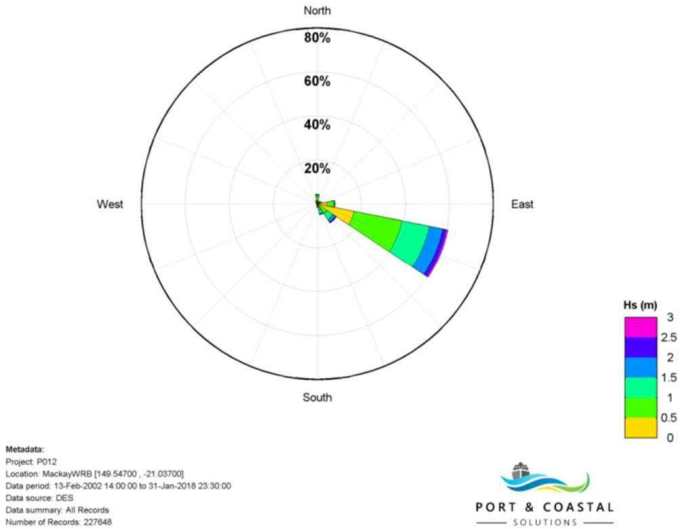

# Port of Mackay - Overview

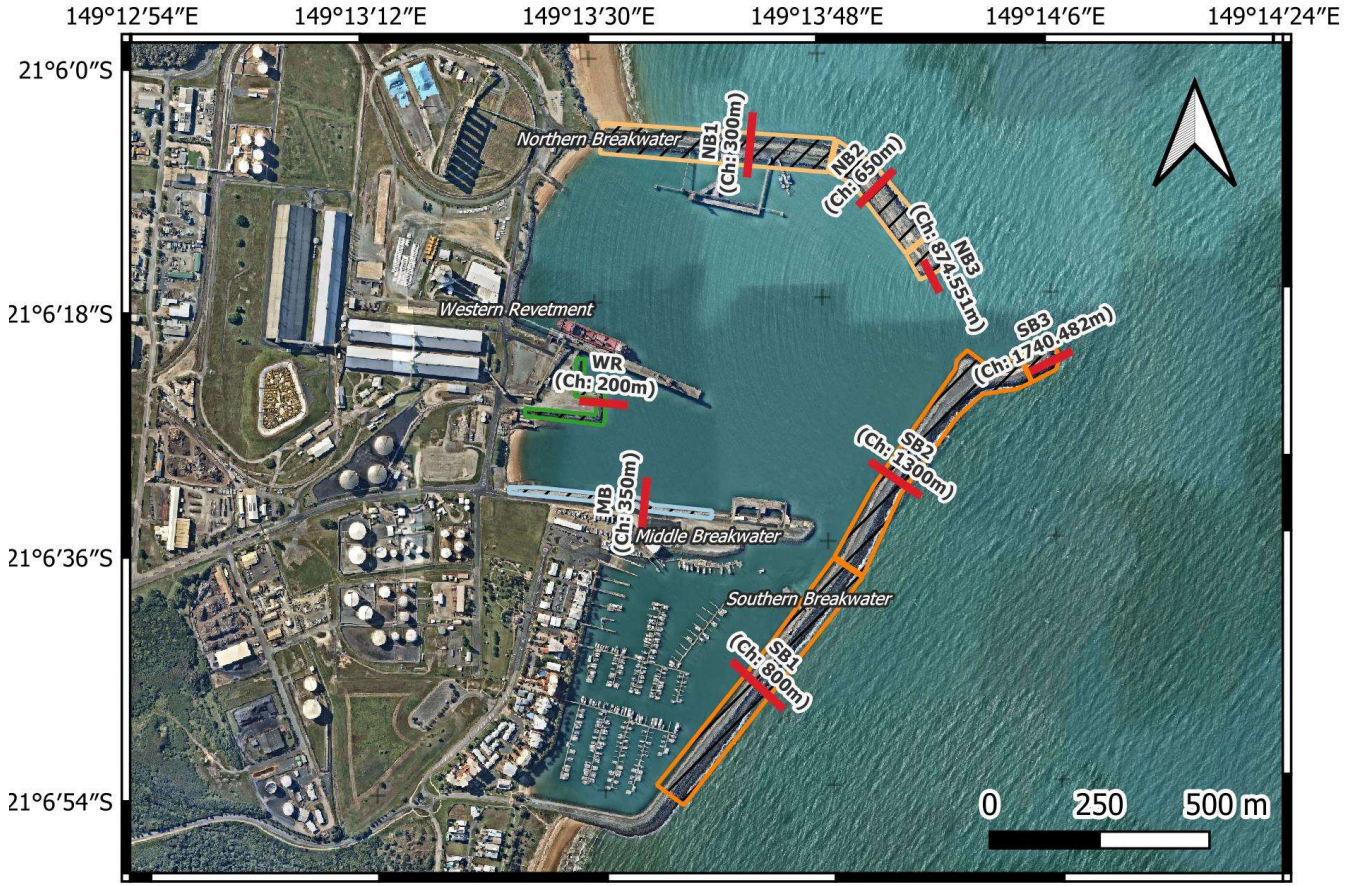



# Port of Mackay – Breakwater parameters


| Structure | Length | Crest | M50 | Slope |
|---|---|---|---|---|
| Northern Breakwater | 900 m | 9.6 to 10 mLAT | 0.44 to 7.4 t | 1:2 |
| Southern Breakwater | 1700 m | 10.0 to 11.6 mLAT | 1 t to 23 t | 1:2 to 1:3 |
| Middle Breakwater | 700 m | 9.7 mLAT | 1.5 t | 1:1.5 to 1:2 |
| Western Revetment | 1000 m | 10.4 mLAT | 0.4 to 2.6t | 1:1.5 to 1:2 |

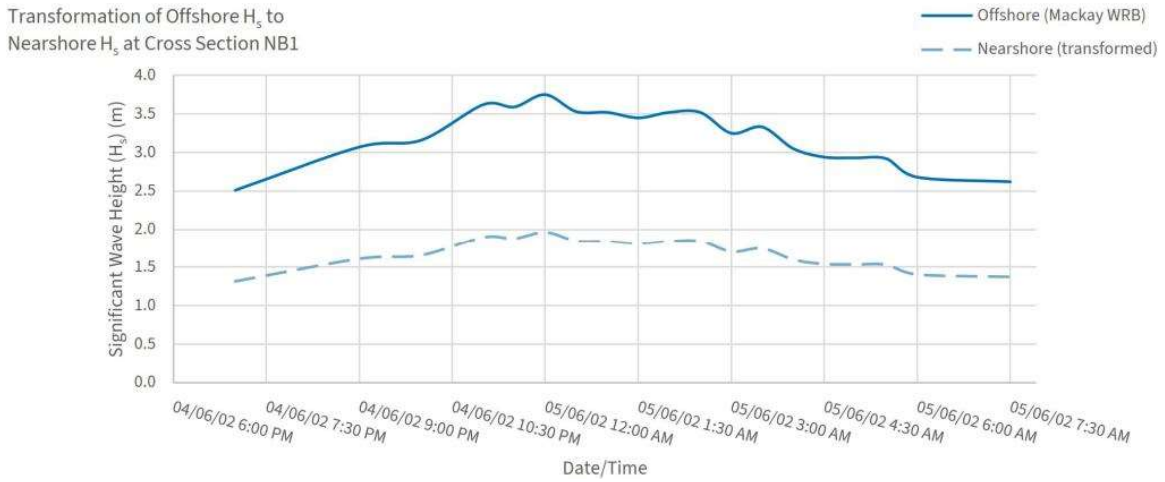
# Port of Mackay – Representative cross-section



# Synthetic Storms

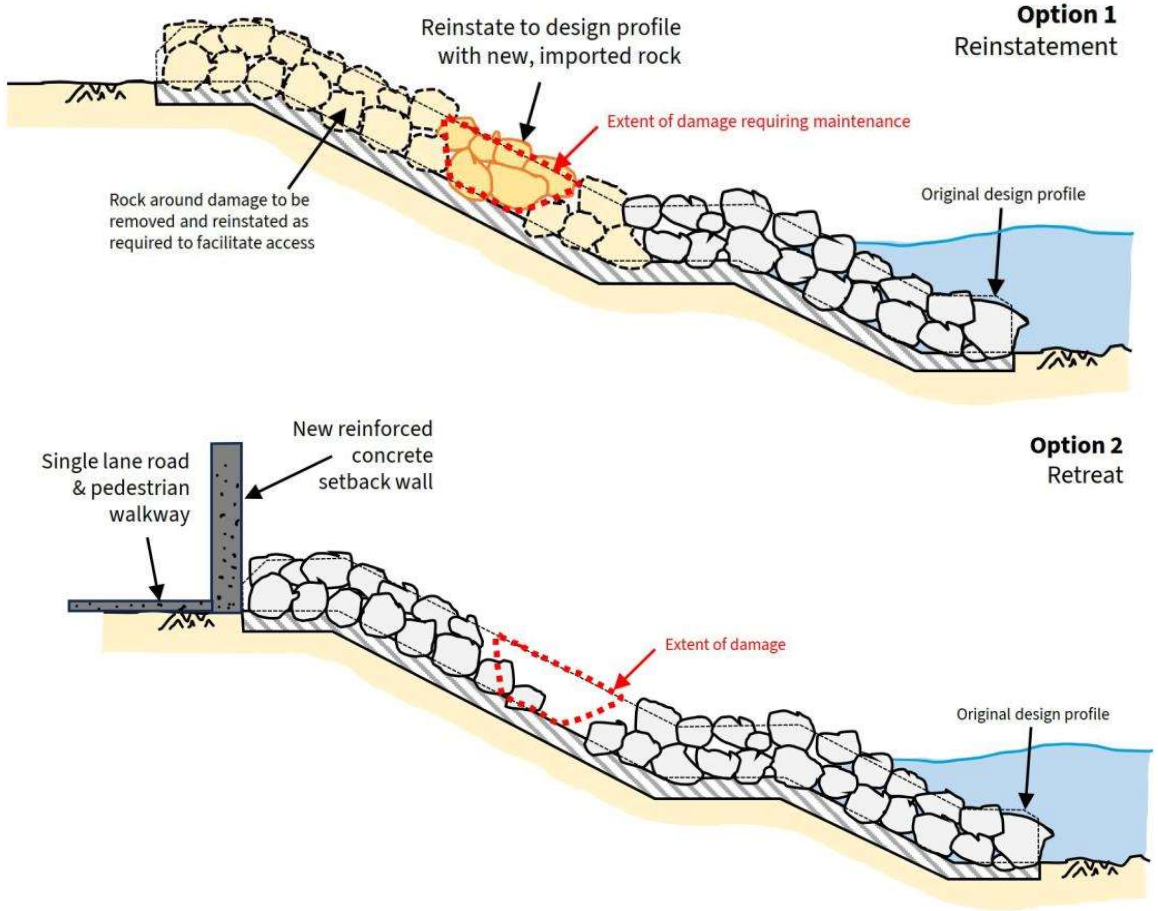
| Storm ID | ARI | Date | Name |
|---|---|---|---|
| 1 | 5 | 04/06/2002 | |
| 2 | 5 | 19/01/2002 | |
| 3 | 50 | 20/03/2010 | TC Ului |
| 4 | 10 | 30/01/2014 | TC Dylan |
| 5 | 20 | 28/03/2017 | TC Debbie |



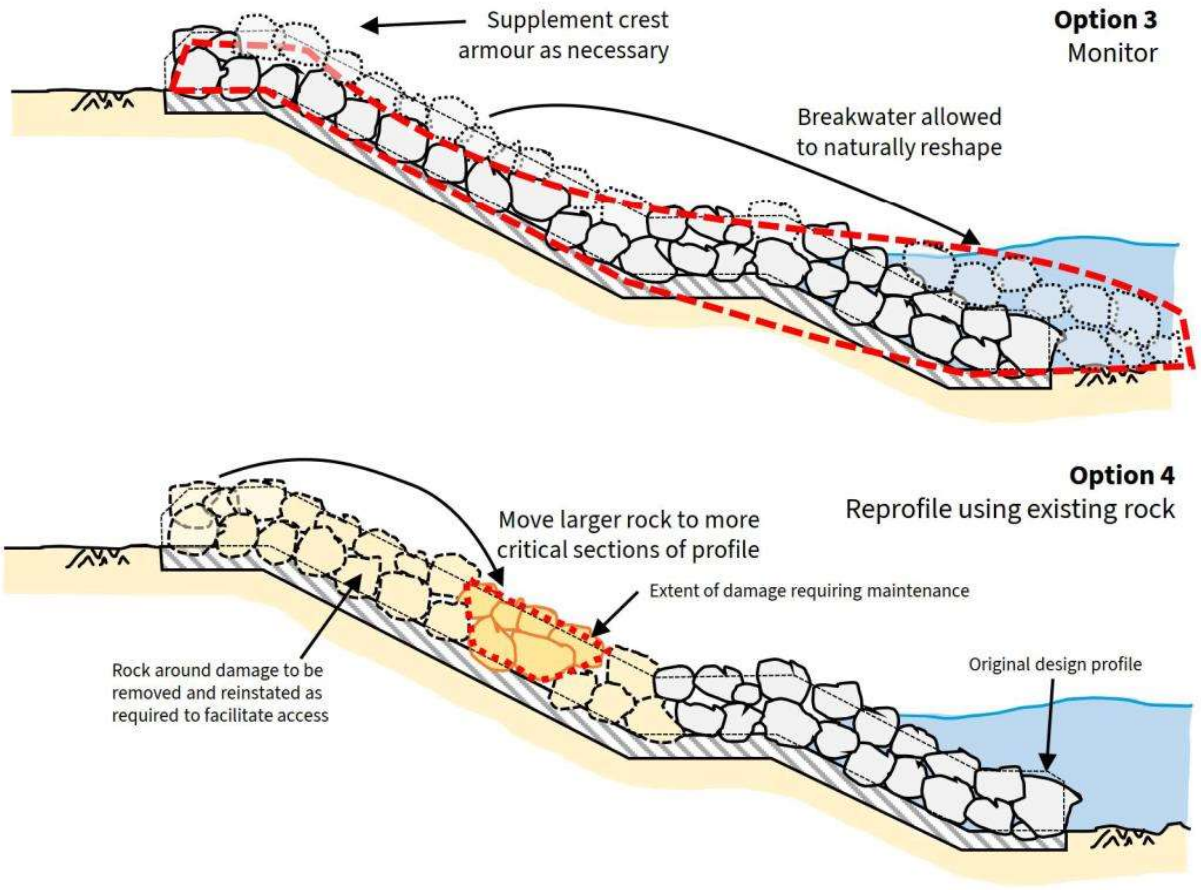
# Maintenance options

- **Option 1:** Reinstatement (base case)
- **Option 2:** Retreat
- **Option 3:** Monitor
- **Option 4:** Reprofile using existing rock
- **Option 5:** Partial progressive overlay upgrade
- **Option 6:** Full replacement of armour layer

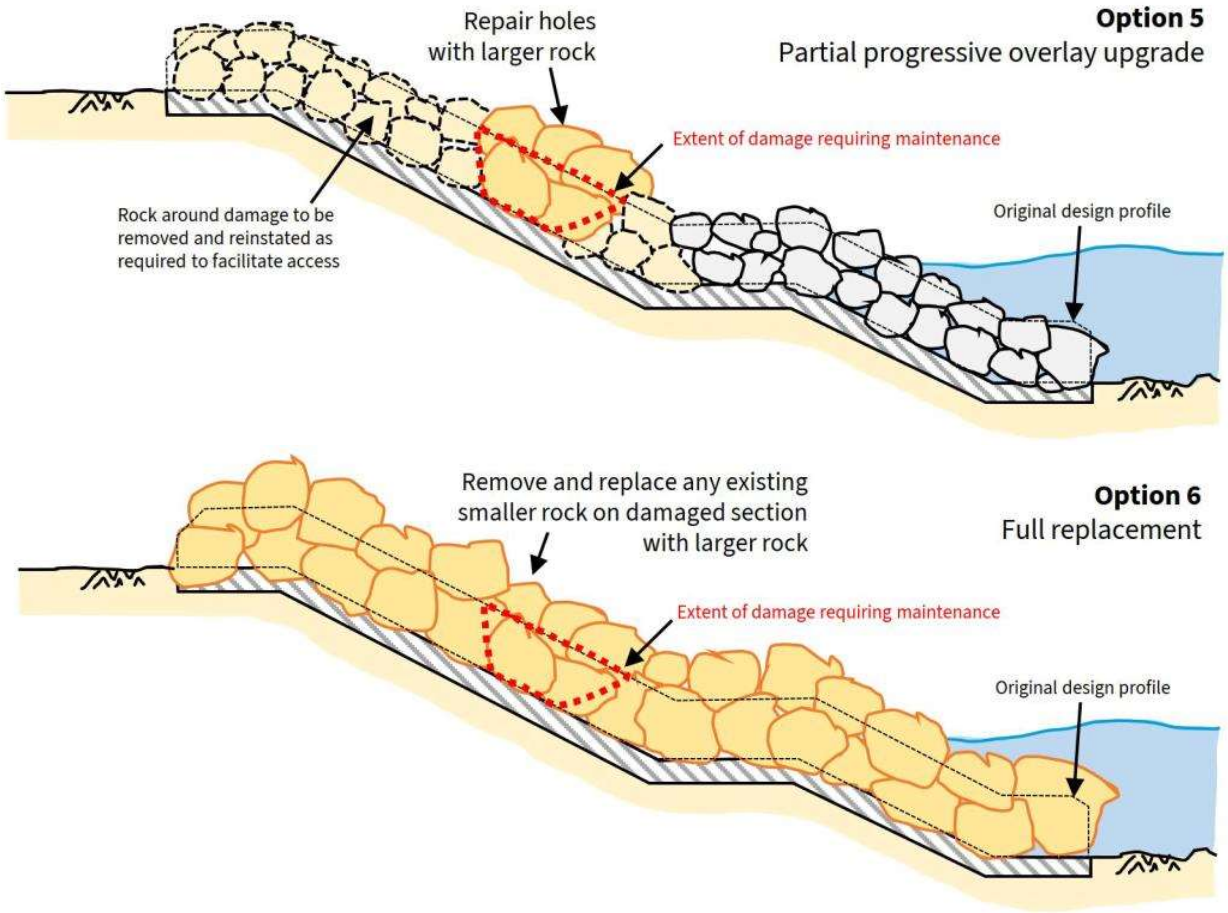
# Maintenance Options – Reinstatement & Retreat



# Maintenance Options – Monitor & Reprofile



# Maintenance Options – Overlay & Replacement



# Shortlisted Options

| Section | Nominated options |
|---|---|
| Northern Breakwater (Profile 1 & 2) | • Option 3 – Monitor<br>• Option 6 – Full replacement |
| Northern Breakwater (Profile 3) | • Option 6 – Full replacement |
| Southern Breakwater (Profile 1 & 2) | • Option 3 – Monitor<br>• Option 5 – Partial progressive upgrade<br>• Option 6 – Full replacement |
| Southern Breakwater (Profile 3) | • Option 6 – Full replacement |
| Western Revetment (Profile 1) | • Option 5 – Partial progressive upgrade<br>• Option 6 – Full replacement |
| Middle Breakwater (Profile 1) | • Option 5 – Partial progressive upgrade<br>• Option 6 – Full replacement |

# BREAKWAT Analysis

| Storm ID | ARI | Date | Name |
|---|---|---|---|
| 1 | 5 | 04/06/2002 | |
| 2 | 5 | 19/01/2002 | |
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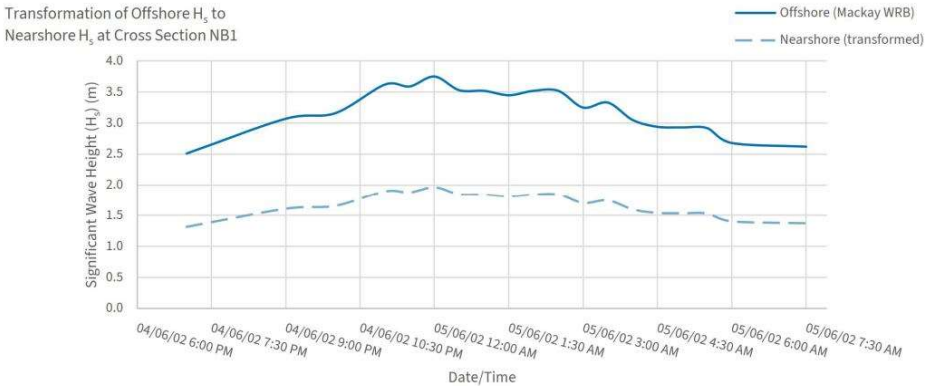
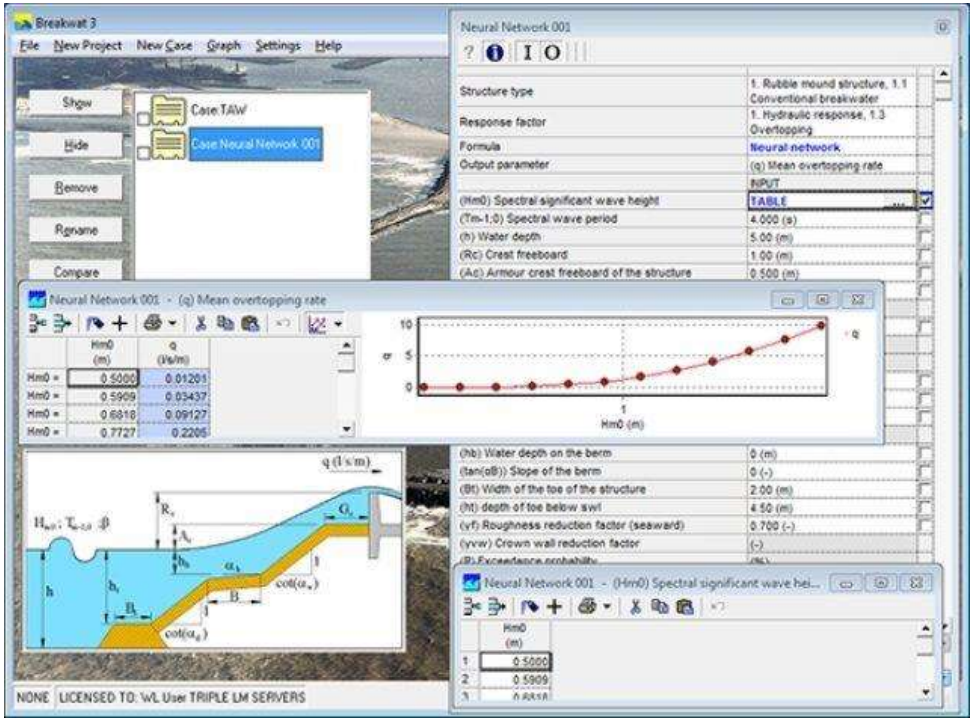
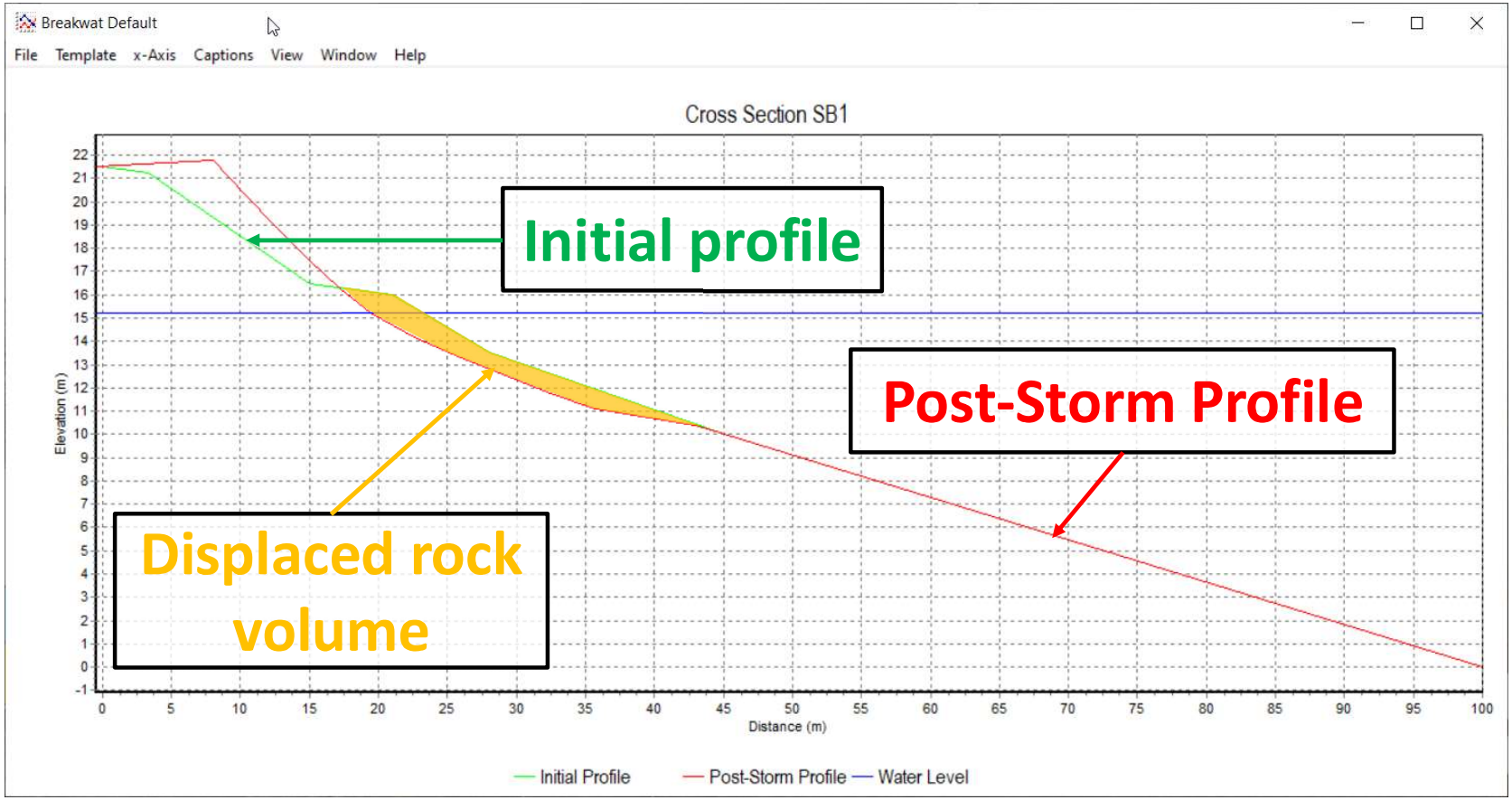
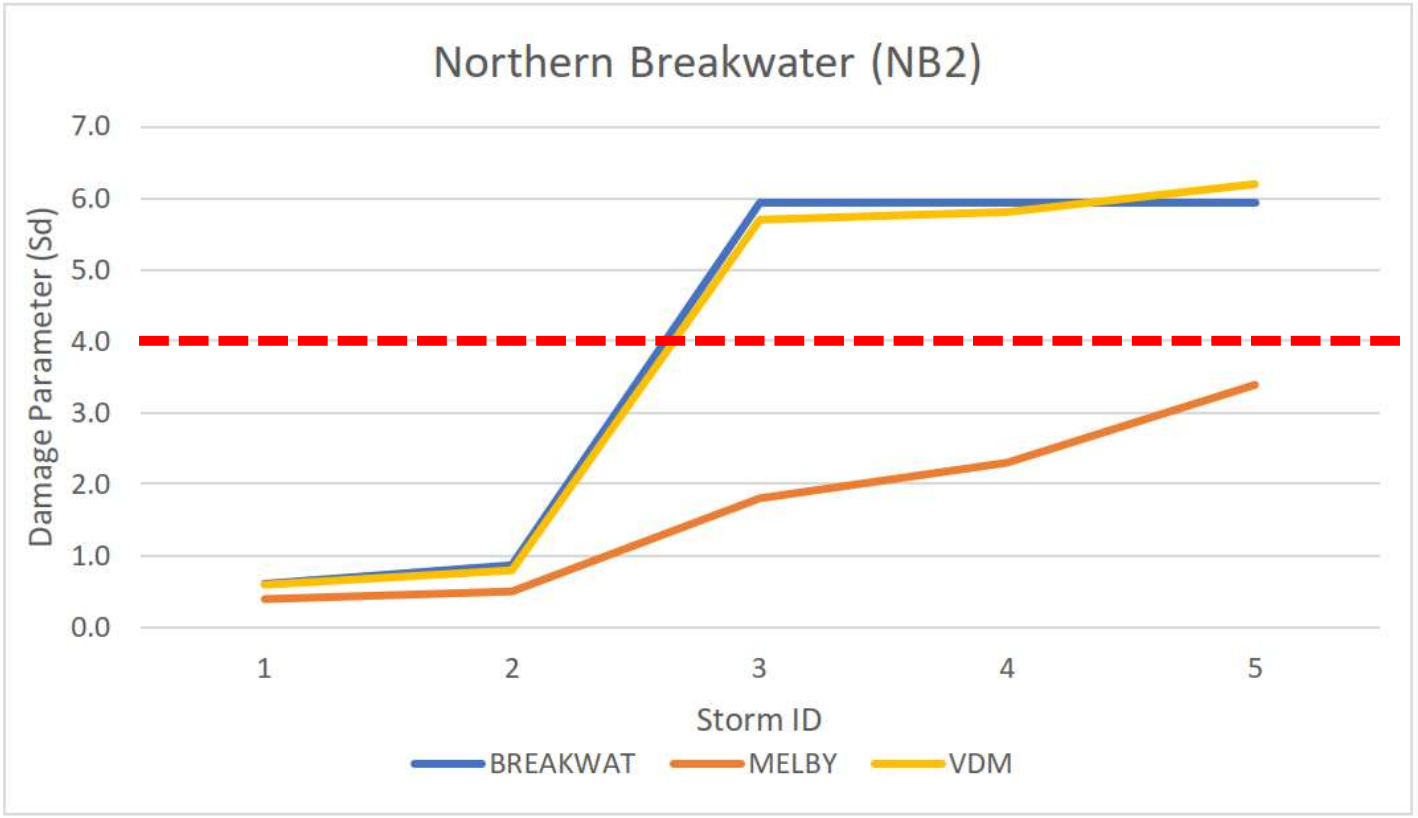


# BREAKWAT Results



# Results – Damage parameter




Sd > 4 triggers repairs

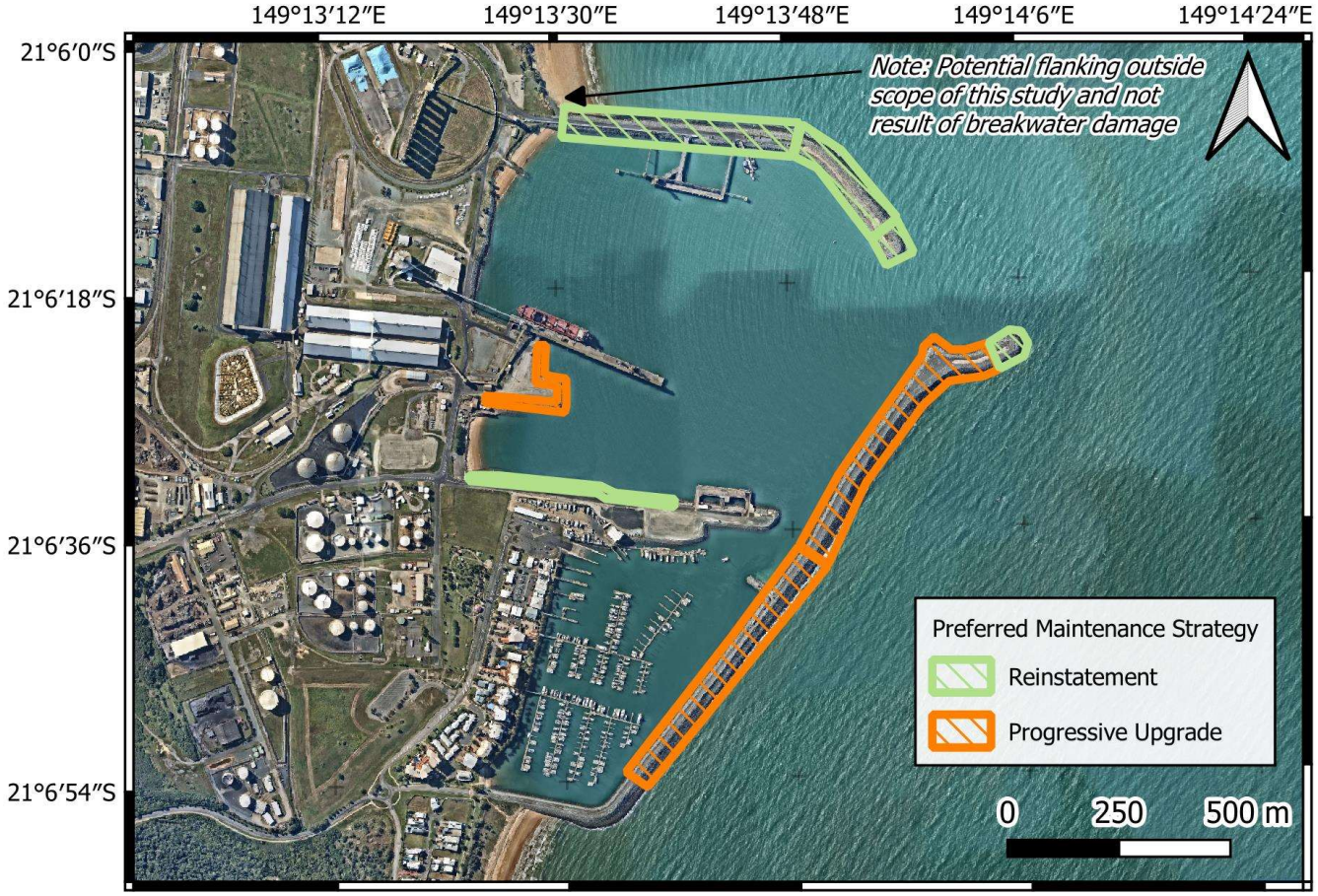
# Results – Tonnes of rock

| Structure | Section | Reinstate | Monitor | Partial upgrade | Full upgrade |
|---|---|---|---|---|---|
| Northern breakwater | 1 | **2,300** | Stable | - | 44,000 |
| | 2 | **1,600** | Stable | - | 13,800 |
| | 3 (Roundhead) | **1,500** | - | - | 0 |
| Southern breakwater | 1 | 49,200 | Instable | **8,300** | 53,950 |
| | 2 | 29,200 | Instable | **8,600** | 53,950 |
| | 3 (Roundhead) | **0** | - | - | 0 |
| Middle breakwater | 1 | **0** | - | 0 | 0 |
| Western revetment | 2 | 2,400 | - | **1,500** | 30,300 |

# Results – $ per m

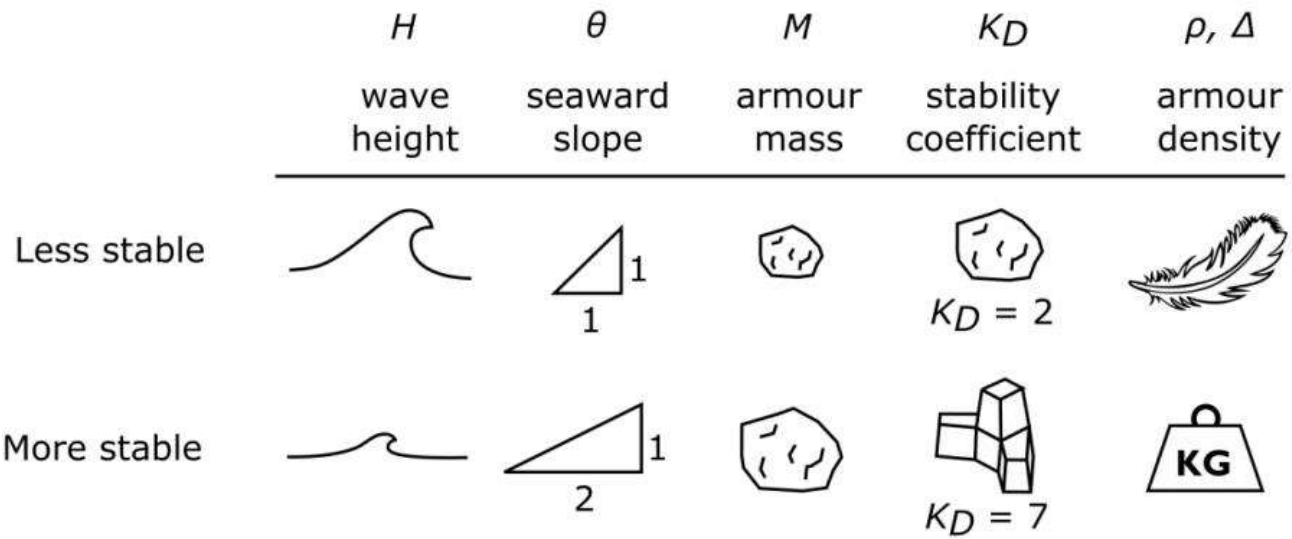
| Structure | Section | Reinstate | Monitor | Partial upgrade | Full upgrade |
|---|---|---|---|---|---|
| Northern breakwater | 1 | **$294** | - | **-** | $6,778 |
| | 2 | **$493** | - | **-** | $4,251 |
| | 3 (Roundhead) | **$462** | - | - | - |
| Southern breakwater | 1 | $4,797 | - | **$1,251** | $5,114 |
| | 2 | $2,658 | - | **$1,063** | $5,114 |
| | 3 (Roundhead) | **$0** | - | - | $0 |
| Middle breakwater | 1 | **$0** | - | - | - |
| Western revetment | 2 | $482 | - | **$370** | $7,468 |

# Recommendations

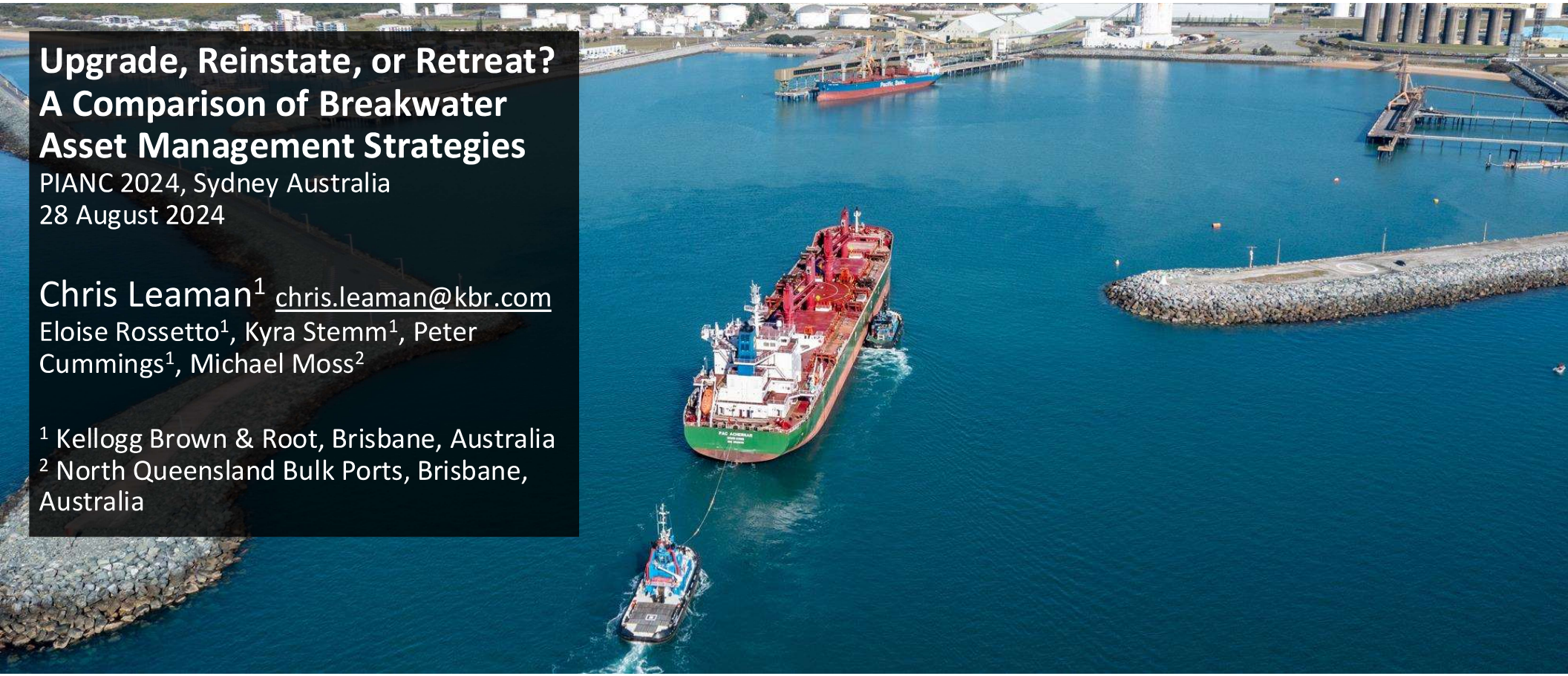


# Future work – Progressive upgrade

Cox, R.J., Howe, D., Modra, B., 2019. Upgrading Breakwaters in Response to Sea Level Rise: Practical Insights from Physical Modelling:



# Questions?



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