Port of Townsville Channel Upgrade Project

Geotextile design considerations for 'closed' rock bund reclamation structures

*United Nations Sustainable Development Goal – to build **resilient infrastructure,** promote inclusive and sustainable industralisation and **foster innovation***

PIANC Asia Pacific Conference

Geotextiles design considerations for 'closed' rock bund reclamation structures

1. **Project Background**
2. Geotextile design considerations / lessons learnt
3. R&D

Project Background

Capital Dredging with the Great Barrier Reef Marine Park
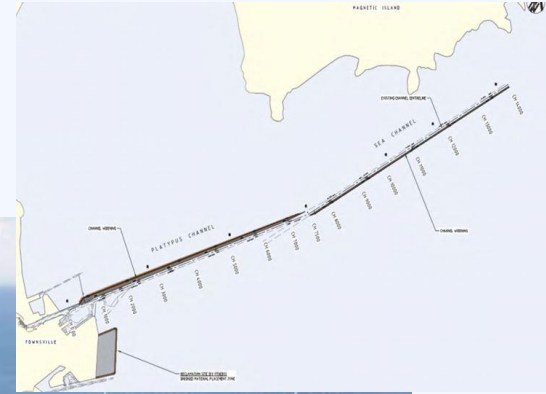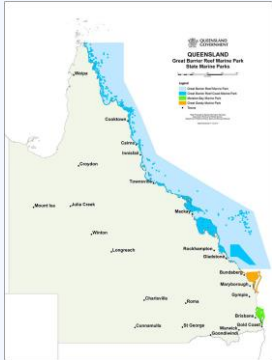
Project Timeline

2018
Environmental approvals received

April 2019
Up to 800,00 tonnes of rock commenced delivery for 2.2km of rock wall

March 2020
Start of rock wall construction

Project Timeline

Interim bund

Temporary Unloading Facility

June 2021
Interim rock bund complete

Interim bund

July 2021
Construction of TUF

March 2022
Dredging commences
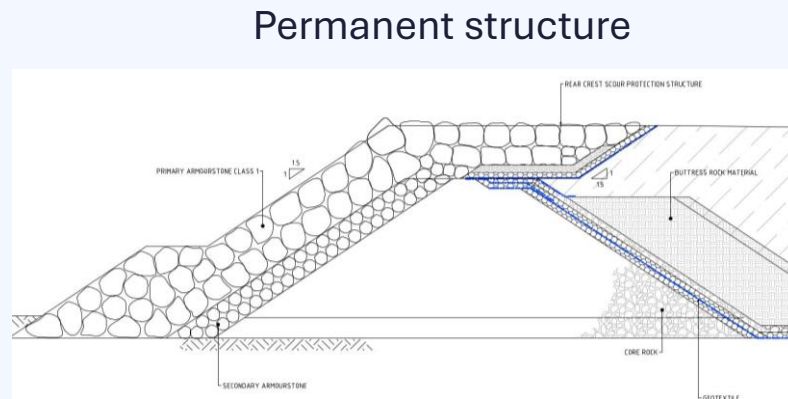
Project Timeline

Permanent bund

Permanent structure

March 2024
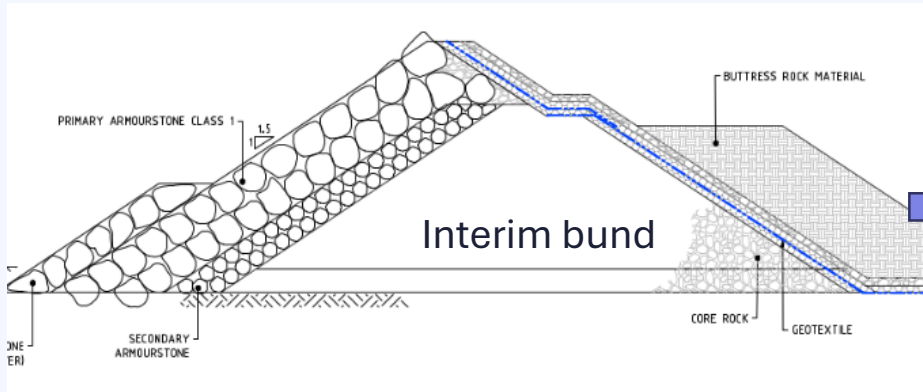Dredging complete

October 2024
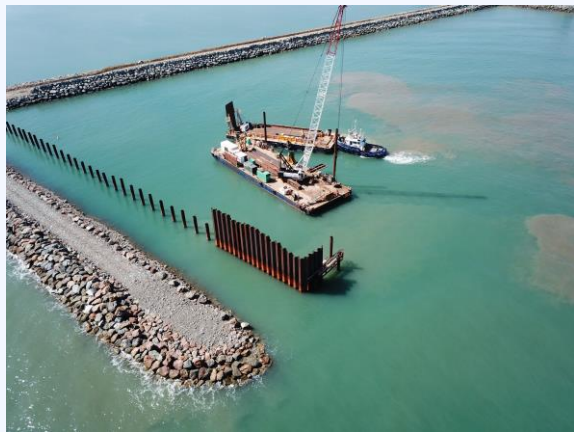Permanent rock wall complete

Interim Rock Bund

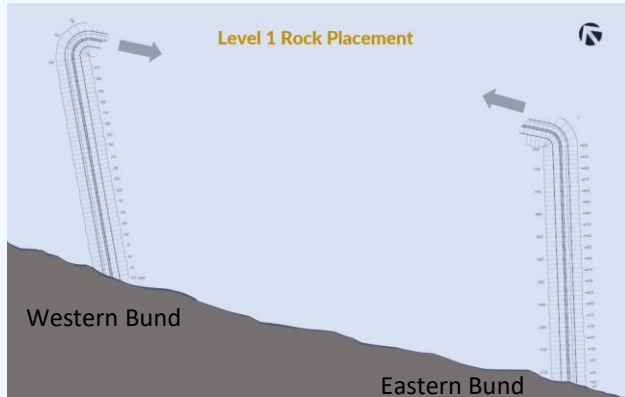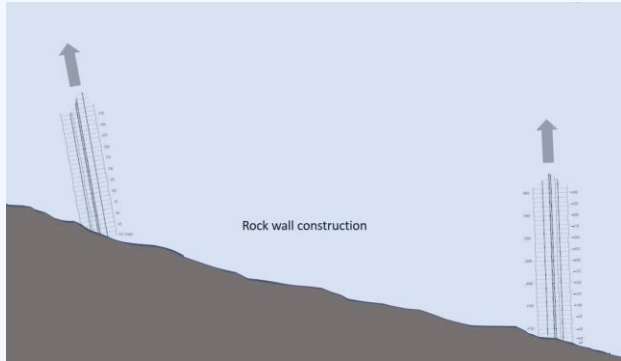**62ha** Of reclamation

Over **800,000** tonnes of rock

Geotextile lined bund

Interim bund

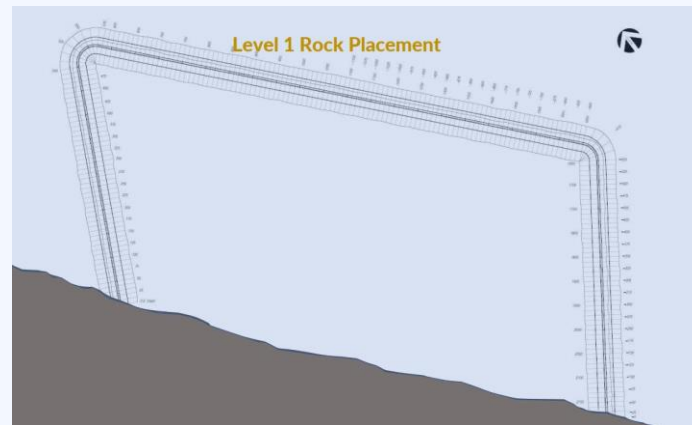PRIMARY ARMOURSTONE CLASS 1
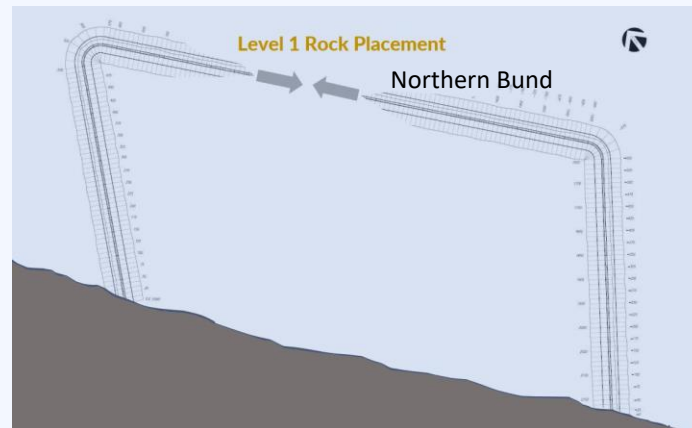
BUTTRESS ROCK MATERIAL

SECONDARY ARMOURSTONE

CORE ROCK

GEOTEXTILE

Temporary Unloading Facility

Rock Bund Build

Rock wall construction

Level 1 Rock Placement

Western Bund

Eastern Bund

Bund Structure Build

Level 1 Rock Placement

Northern Bund

Level 1 Rock Placement

Geotextile lining

Northern Bund

Clay lining

Western Bund

Eastern Bund

Reclamation - perimeter seal

Clay lining

Reclamation January 2023
Photo provided by Hall Contracting

Clay Lining
Northern Bund
Eastern Bund
Western Bund
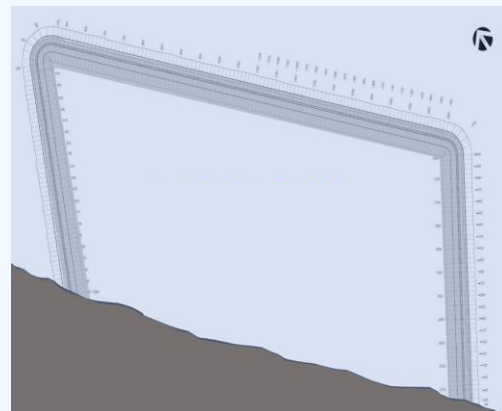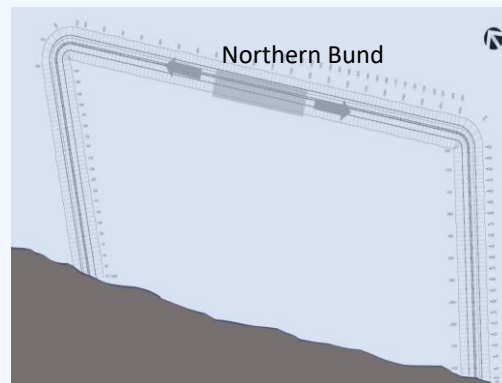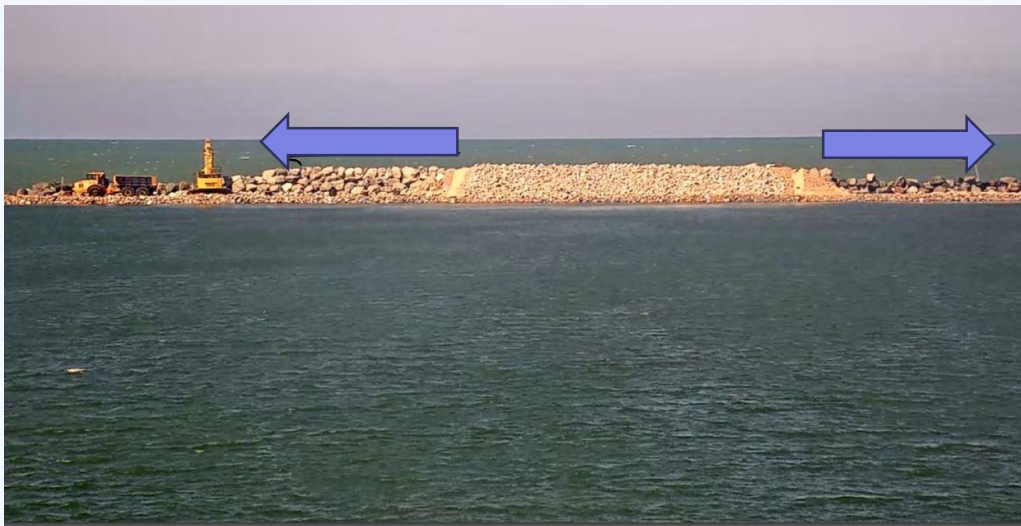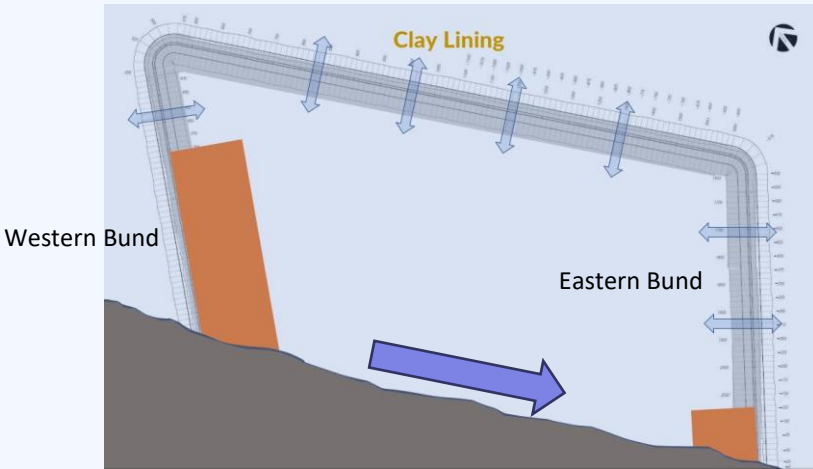
Clay Lining
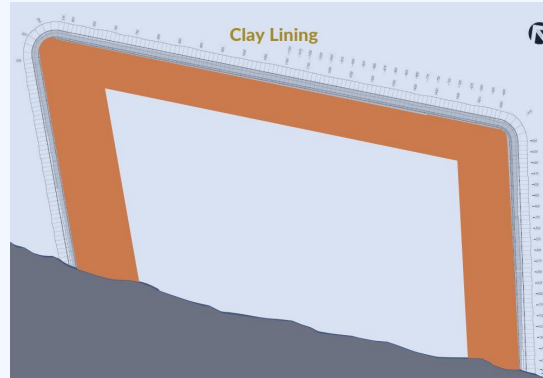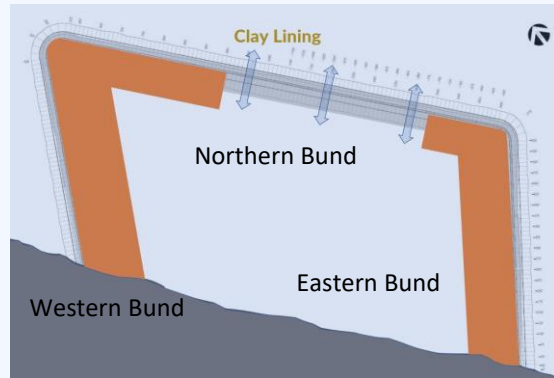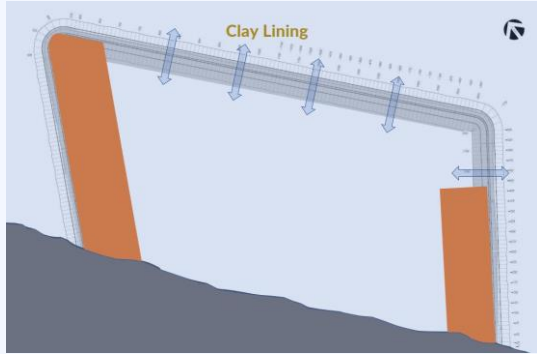
Rear Crest Scour Protection
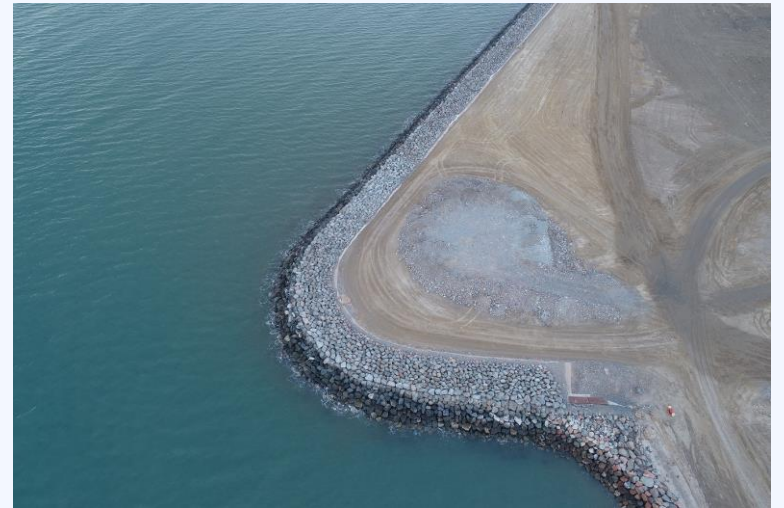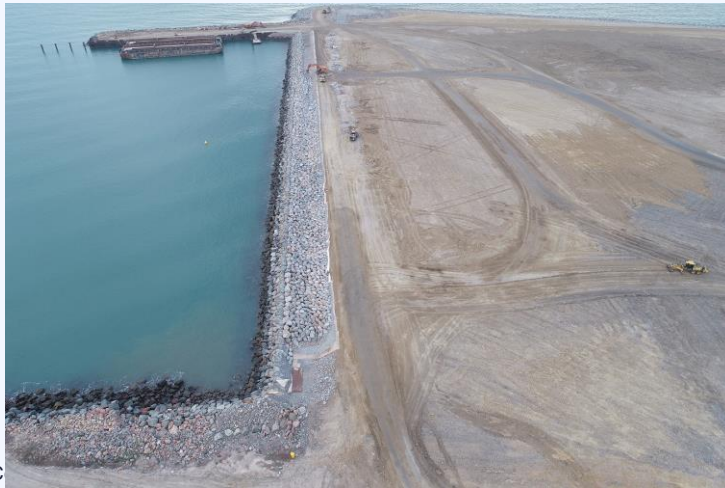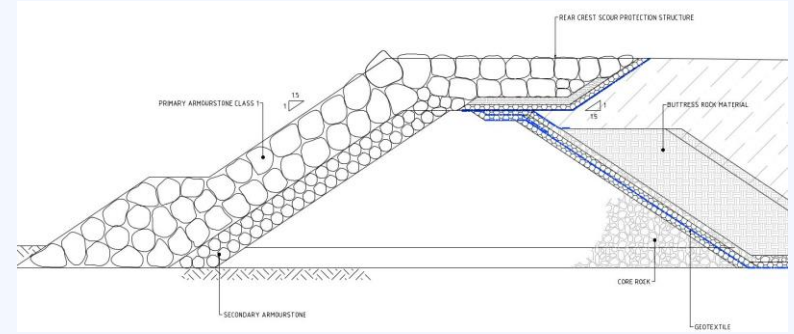
Geotextiles design considerations for 'closed' rock bund reclamation structures

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Geotextile Design Considerations

Dry Trials - Testing for Strength/ Elongation
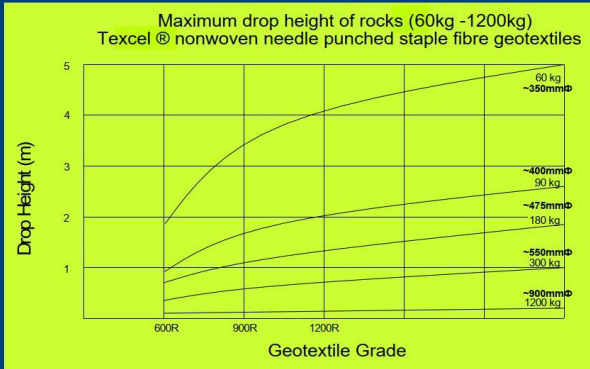
Geotextile Design Considerations

Dry Trials - Testing for Strength/ Elongation
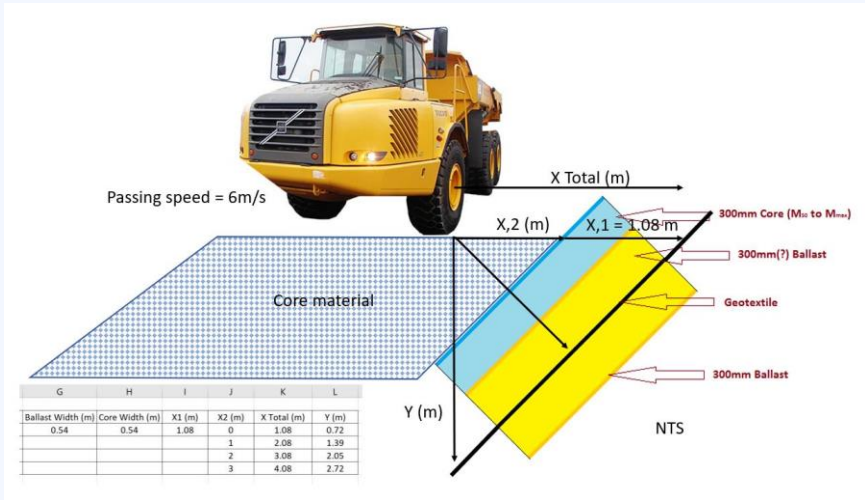
Geotextiles design considerations

1209RP non-woven needle punched geotextile
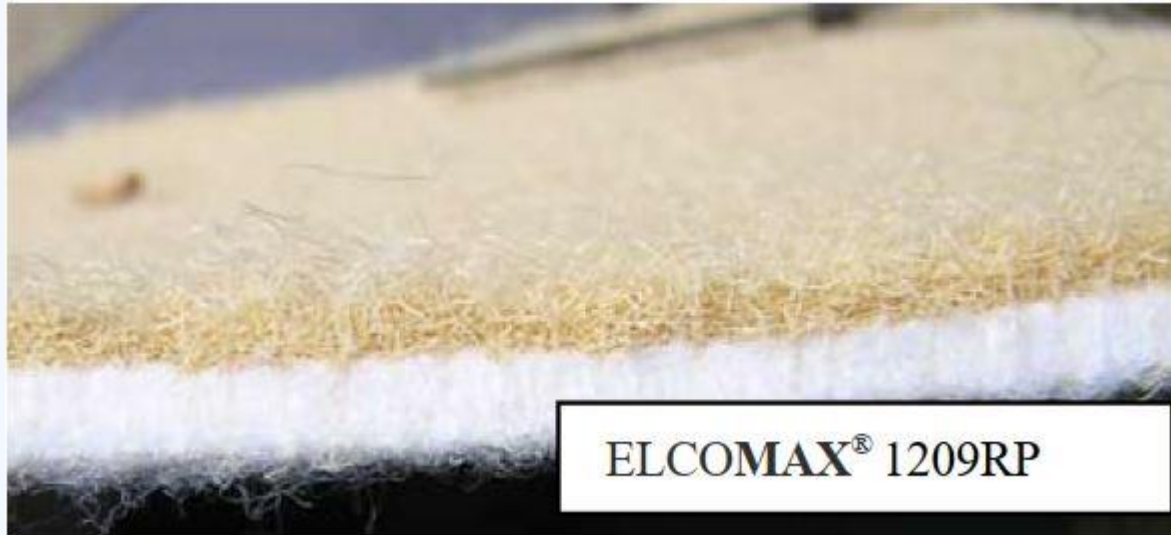
AnAqSim™

Rock – 1000 m/day

1209RP – 145 m/day

Clay lining – 0.001 m/day

Geotextile design considerations

Transmissivity/ permeability and hydraulic stability
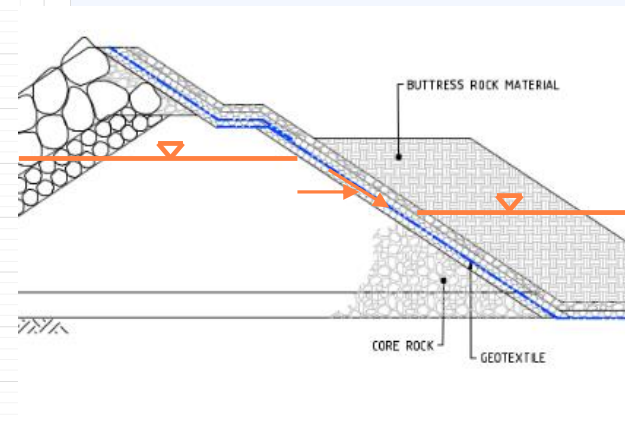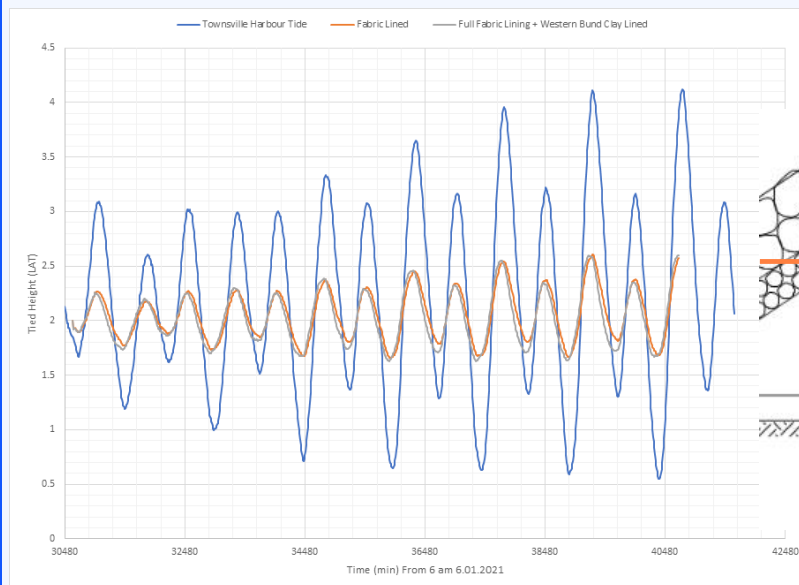
Geotextile design considerations

Tidal lag estimates

AnAqSim™

Scenario	Linear Extent of Clay Lining (Chainage, m)	+4.1m LAT Tide	+3.6m LAT Tide	+3.0m LAT Tide
		Predicted Tidal Lag (m)		
1	0	1.5	1.2	0.8
2	550	1.5	1.2	0.8
3	1075	1.8	1.4	0.9
4	1625	2.0	1.5	0.95
5	2177* (fully clay lined)	2.1	1.6	1.0

*values estimated, not modelled

Scenario 1 Fully geotextile lined (no clay)

Scenarios 2 to 5 Progressive clay lining

Geotextile design considerations

Model validation

AnAqSim™

Scenario	Linear Extent of Clay Lining (Chainage, m)	+4.1m LAT Tide	+3.6m LAT Tide	+3.0m LAT Tide
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August 2021 Differential for 3.87m tide - 0% Reclamation Seal, 1.75hr Peak Tide Time-Lag

Scenario 1 Fully geotextile lined (no clay)

Scenario 2 to 4 Progressive clay lining

Geotextile design considerations

Flow Theory

Steady Flow in an Unconfined Aquifer

- $K = 10^{-1}$ cm/sec
- $L = 150$ m
- $h_A = 6.5$ m
- $h_B = 4$ m
- $x = 150$ m
- Find Q
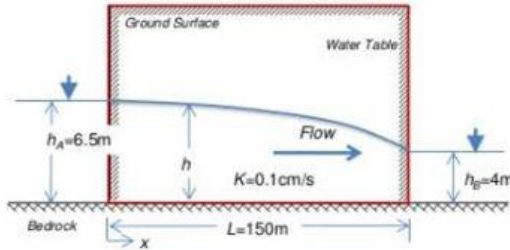
$$Q = \frac{K}{2}\frac{h_B^2 \; h_A^2}{L} \div = \frac{86.4 \; m/d}{2} \frac{6.5^2 \; 4^2}{150} \div = 7.56 \; m^3/d/m$$

H_t & η

Flow efficiency

Total head

$H_t = h_s + KQ^2$

$KQ^2 =$ Friction & velocity head

Head $= H_t$

$h_s =$ Static head

Flow $= Q$

Geotextile design considerations

TEXCEL 1209RP NONWOVEN STAPLE FIBRE GEOTEXTILES

The values published in this leaflet are to the best of our knowledge true and correct. The product specification may change at any time without prior notice. No warranty is expressed or implied. Manufactured by Geofabrics Australasia Pty Ltd to the ISO 9001 Quality Management System Standard.
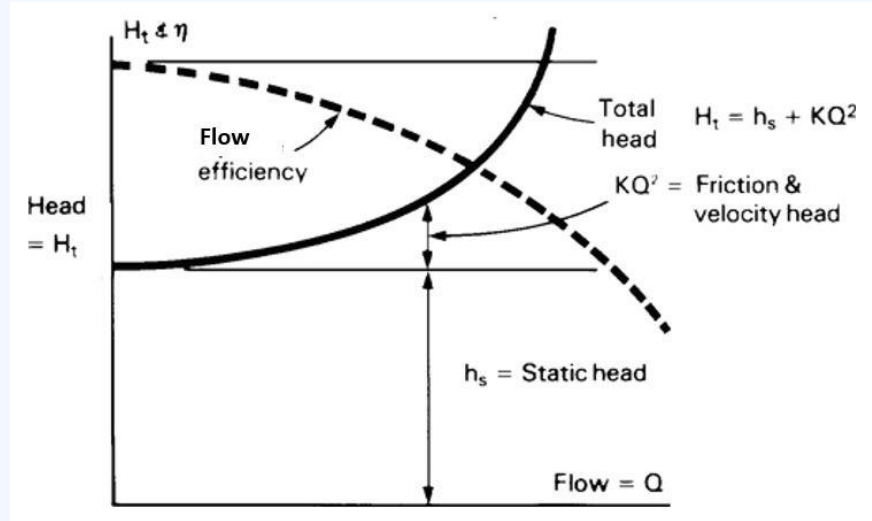
PROPERTY	TEST METHOD	UNITS	VALUE[1]
Fibre Type	Polyester/Polypropylene		
Mass	AS3706.1	g/m²	2,200
Thickness	AS3706.1	mm	12
Bond Strength of Geocomposite Ply Adhesion	ASTM D7005	N/m	6000
CBR Burst Strength	AS3706.4	N	13,200
Wide Strip Tensile Strength MD	AS3706.2	kN/m	50
Wide Strip Tensile Strength XMD	AS3706.2	kN/m	85
Wide Strip Tensile Elongation MD	AS3706.2	%	100
Wide Strip Tensile Elongation XMD	AS3706.2	%	85
Abrasion Resistance MD/XMD	BAW Rotating Drum	% Strength Retained	>75
Hydrocarbon (Diesel) Resistance MD/XMD	AS3706.12	% Strength Retained	>90
UV Resistance 500 Hours	AS3706.11	% Strength Retained	>90
Pore Size O95 - Sieve Method	AS3706.7	μm	<75
Permittivity	AS3706.9	s⁻¹	0.15
Coefficient of Permeability	AS3706.9	m/s x 10⁻⁴	16.8
Flow Rate @ 100mm head	AS3706.9	l/m²/s	15

1. All values are typical, 2. MD=Machine Direction, 3. XMD= Cross Machine Direction

Scenario	Linear Extent of Clay Lining (Chainage , m)	+4.1m LAT Tide	+3.6m LAT Tide	+3.0m LAT Tide
1	0	1.5	1.2	0.8
2	550	1.5	1.2	0.8
3	1075	1.8	1.4	0.9
4	1625	2.0	1.5	0.95
Fully clay lined*	2177	2.1	1.6	1.0

*values estimated, not modelled
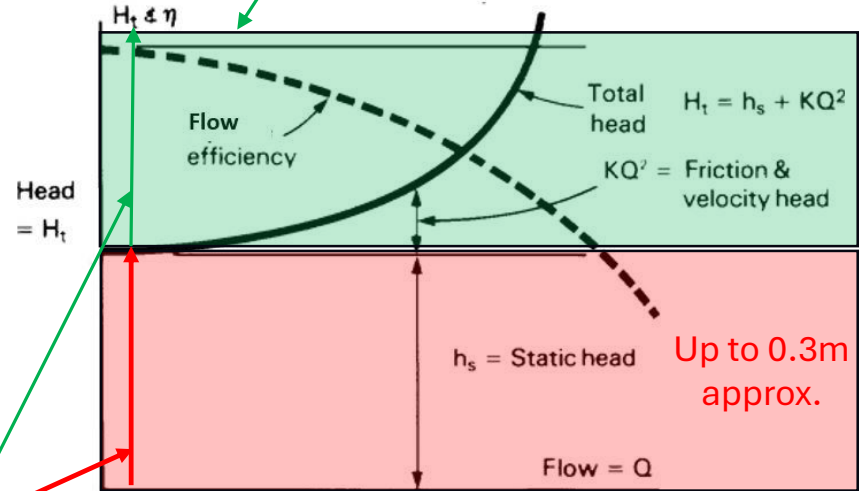
$H_t = h_s + KQ^2$

KQ^2 = Friction & velocity head

h_s = Static head

Flow = Q

Up to 0.3m approx.
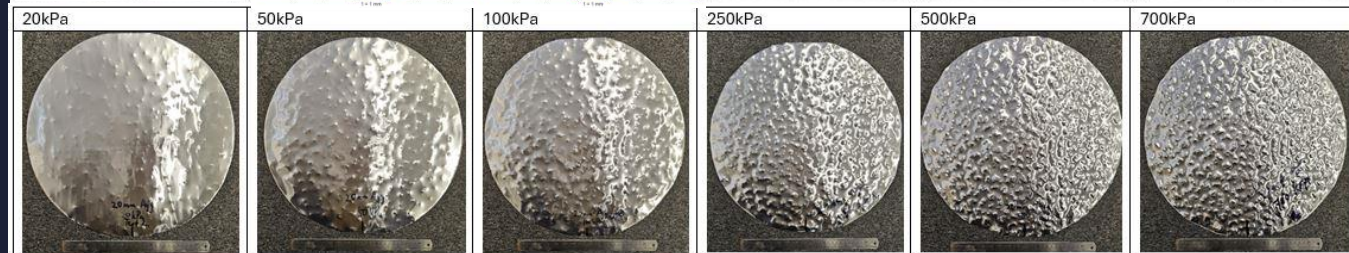
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< 20 mm aggregate

20 to 40 mm aggregate
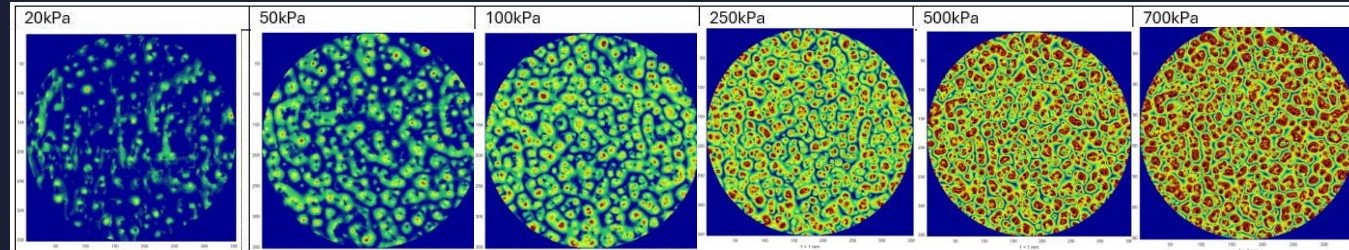
Key conclusions

Limited design guidance available

Geotextile survivability

Permeability of geotextile should be assessed by a suitably qualified hydrogeologist

Modelling construction staging for geotextile lining and clay backing

Geotextile R&D – Watch this space!
PIANC Working Group?

Any Questions?

SJ **∿∘smec**

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