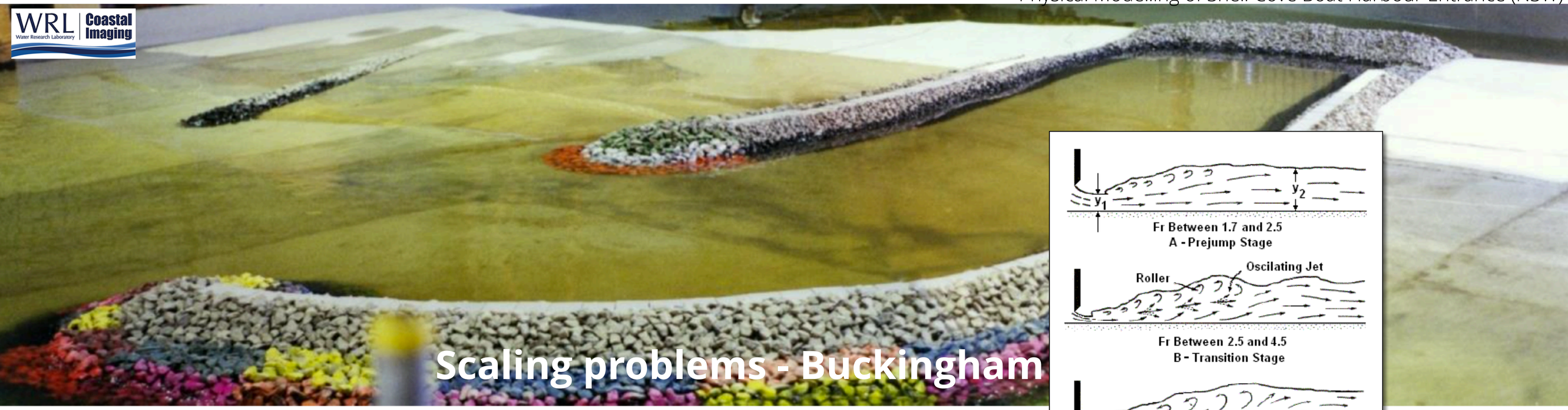
Physical modelling: laboratory models

Physical Modelling of Shell Cove Boat Harbour Entrance (NSW)



Scaling problems - Buckingham

- Froude number: ratio of flow inertia to gravity

$$\pi_2 = V^1 L^{-1/2} F^0 \rho^0 \mu^0 g^{1/2} = V / (gL)^{1/2} = Fr$$

- Fr=1: critical flow
- Fr>1: supercritical flow (fast rapid flow)
- Fr<1: subcritical flow (slow/tranquil flow)

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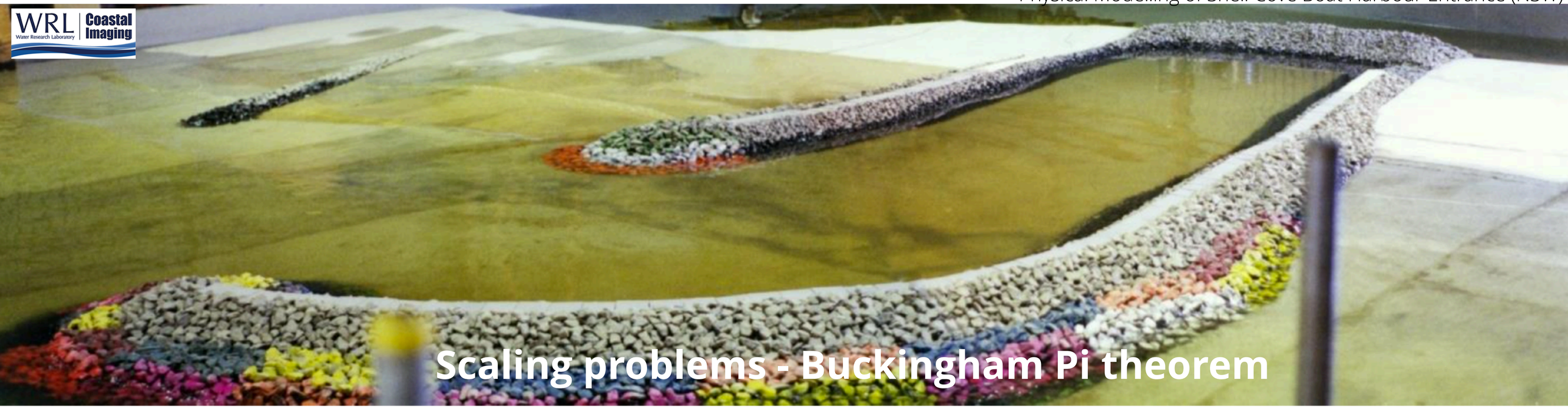

$$\frac{Inertia\ force}{Gravity\ force} = \frac{F_i}{F_g} \propto \frac{\rho U^2 L^2}{\rho g L^3} = \frac{U^2}{gL}$$

Dynamic similarity requirement between model and full scale:

$$\frac{U_M}{\sqrt{gL_M}} = \frac{U_F}{\sqrt{gL_F}} = Fn$$

- Equality in Fn in model and full scale will ensure that gravity forces are correctly scaled
- Surface waves are gravity-driven ⇒ equality in Fn will ensure that wave resistance and other wave forces are correctly scaled