MARINE MODELLING IN SUPPORT OF KOOLAN ISLAND MINE RECOMMENCEMENT AND EVENTUAL DECOMMISSIONING

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INTRODUCTION

Koolan Island is located in a remote macrotidal (9m mean spring range) area of the Buccaneer Archipelago of NW Australia. High-quality hematite has been mined from the island since the 1940s, with direct export by ore carriers from a dedicated marine terminal. Mining in recent decades has focused on an open pit immediately adjacent to the ocean. The initial operator decommissioned the site in 1993, at which time a channel connecting the pit to the sea was excavated, the pit was flooded and a productive marine ecosystem developed within the photic zone of the former mine.

The site was subsequently acquired by Mt. Gibson Iron, which drained the pit in 2007 and constructed a protective seawall to facilitate additional ore extraction through the extension of the pit both in depth as well as closer to the historical shoreline. A catastrophic failure of a section of the seawall in 2014 re-flooded the pit, which resulted in no injuries as the site was successfully evacuated in response to instrumented movements in the seawall structure. Construction of a strengthened seawall has recently been completed, and pit dewatering activities will be initiated during the week of the ICCE conference to enable in-Pit mining activities to recommence by the end of 2018.

The presentation will present a summary of the unique history of the site, as well as supporting numerical modelling performed to describe a) the complex regional and local macrotidal dynamics, b) sediment spillage in connection with the reconstruction of the seawall following the 2014 failure, and c) coupled 2D/1D model calculations optimizing channel geometry to ensure adequate flushing of the pit following its eventual re-flooding in connection with final decommissioning.

METHODS

A series of numerical modelling work packages have been executed in support of the recommencement of mining operations, the re-establishment of the seawall following its 2014 partial collapse, and future planning for the final decommissioning of the Koolan Island Main Pit:

- A regional-scale unstructured mesh hydrodynamic model was established, with locally enhanced resolution sufficient to force a quasi-3D Lagrangian model study of sediment spillage associated with the potential seaward expansion of the seawall prior to its failure in 2014
- The hydrodynamic model was further enhanced and validated in support of a Eulerian sediment transport model assessing potential impacts from sediment spilled in conjunction with placement of rock fill during the closure of the seawall breach section
- Ongoing work focuses on eventual site decommissioning. An initial phase identifies a suitable conceptual design for a permanent, stable channel design configured to ensure high water quality within the upper water column of the pit lake. A follow-up phase will address the character of the full water column of the decommissioned pit (once the above channel is in place) using a 3D water quality model.

Figure 1 – Koolan Island following re-closure of main pit seawall (Nov 2017) and temporary ponding of Pit lake.

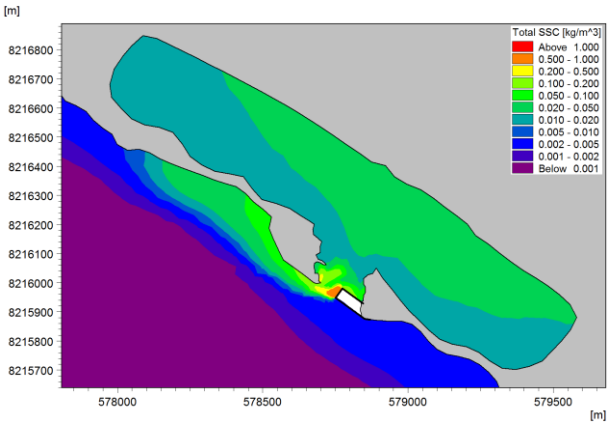

Figure 2 – Detail of hydrodynamic / cohesive sediment transport model showing partially closed seawall gap and sediment spillage by end tipping of rock during 2017.

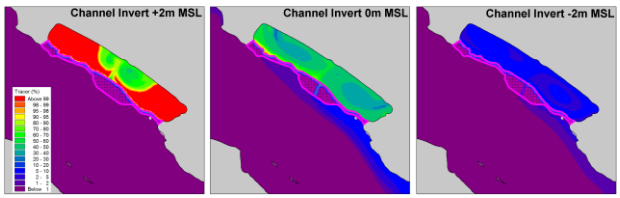

Figure 3 – Flushing response of upper water column of decommissioned pit, as tracer percentage after 7 days for three candidate channel geometries.