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Gordon Dwane 2 Nov 2018
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Re: Independent Reviewer for the Port of Gladstone Sustainable Sediment Management Project

AIMS has been commissioned by Gladstone Ports Corporation (GPC) to provide an independent review to assist in the delivery of the Port of Gladstone (PoG) Sustainable Sediment Management Project (SSMP).

This letter represents AIMS review of the following components of the SSMP:

- Conceptual Sediment Budget for the PoG. (WBS: 2.2.4);
- Gap Analysis and Sampling Strategy.

The above tasks are defined in Gladstone Ports Corporation Doc No.: #1410482 (as Tasks 1, 2a, and 2b).

The Draft Conceptual Sediment Budget and Gap Analysis and Sampling Strategy were provided in the following documents:

- SSM_Conceptual_Sediment_Budget_P009_R02D02.pdf
- P009_R03D02_GapAnalysisSamplingStrategy.pdf

Review of Conceptual Sediment Budget:

- The development of the conceptual sediment budget has considered an appropriate and comprehensive number of processes likely to influence the distribution and movement of sediment within the PoG. The approach utilises a range of physical oceanographic, meteorological and hydrological data to define the physical processes acting in sediments throughout different regions of the PoG, together with description of sediment characteristics and historical assessment of sediment distributions and detailed spatial patterns of sedimentation and erosion from hydrographic surveys to infer sediment transport mechanisms and transport pathways. The resultant understanding is presented in the form a conceptual budget of sediment movement.
- The conceptual budget captures all relevant processes, and forms logical conclusions regarding zonation of sediment distributions and sediment movement pathways, based on existing data sets.
- The large-scale and conspicuous natural geomorphological features of the harbour are consistent with the processes described in the conceptual budget, adding confidence to the process understanding. These features have developed over long timescales and represent

an integration of the various shorter term process that control sediment movement of shorter (daily – seasonal – interannual) timescales. The report uses the existence of these features as evidence to support the logic of the conceptual budget. In some case, I think that these features could also be used to clarify what could appear as possible contradictions in the report. For example, there is the need to reconcile the description of the inner harbour hydrodynamics as ebb dominated and by extension, potentially supporting export of sediment (suspended or bed load) with the description in the conceptual budget that the inner harbour is a sink for fine sediment. These 2 ideas are not incompatible if the discussion separates suspended sediment separately from potential bed load movement. For example, faster currents that prevail in the deeper channels, and which show an ebb dominance, are likely to move heavier sediment in a nett direction out of the inner harbour. Fine grained sediments are more likely to stay in suspension and remain so, until they are advected in to lower energy areas and ultimately deposited. So while the currents may show an ebb dominance, combined with the decreasing gradient of tidal energy, the inner harbour acts as a sink for fine sediment while acting as a source/export for coarser grained material in the deeper channels. This is supported by the evidence of sediment characteristic grain size analysis and existing morphological features such as East and West Bank.

- The estimate that 8.5 Mt of sediment is resuspended within Port Curtis each year is based on a logical extrapolation of existing data and modelling. The comparison of the mass of resuspended material (per annum) to the inputs from the Calliope and Boyne Rivers (on Page 48) needs to be more carefully explained. The resuspended material is material that is already in the dynamic sediment system in the harbour, while the river inputs are new. The point of comparison needs to be made clear. If it is in relation to the sediment budget, then the resuspension total is not a source or sink term, whereas the inputs are source. If the comparison is made in respect to total sedimentation, then the nett sedimentation of the resuspension of existing material should be compared to the likely nett sediment of the new inputs.
- The locations of Port of Gladstone declared channels and sea disposal site (presented in Figure 3) are very difficult to read.

Review of Gap Analysis and Sampling Strategy:

- The gap analysis is consistent with the understanding presented in the conceptual budget, and the specific processes that require further definition.
- It would be good to understand the relevant and related space and time-scales of the ADCP transects. i.e. how long will it take to complete a transect across the harbour, particularly for the Sth Transect?. This transect looks to be ~ 4km. At 4 knots, a traverse across the harbour and back should take ~ 1hour. If survey seeds are slower, the effectiveness of the transects may suffer with too much change in currents between repeat transects, making interpretation more challenging. It may be worth considering two transect vessels, each doing half of the channel, in a co-ordinated manner. The transects should also be undertaken for 13 hours to ensure that they capture a full period of an M2 tide (12.4 hr).
- It is proposed to also deploy fixed Loggers (SSC, PSD, settling velocity, hydrodynamic and wave conditions) at fixed sites in very close proximity to the ADCP transect locations. This

will aid in interpretation of the ADCP transect data to discriminate temporal and spatial variability.

- For fixed logger within the harbour and those proposed for the EBSDS, downward facing high resolution ADCPS should be considered in addition to the bottom mounted, upwards facing AWAC ADCP. Downward facing high resolution (1-2MHz) mounted ~2m above the bed, combined with the proposed upwards looking ADCPs will provide full water column coverage for current and backscatter. Full water column information will enable more accurate estimation of SSC flux through the EBSDS. In addition, the downward looking ADCP will provide richer detail on the conditions that favour resuspension, as well as providing information on bed-load transport – that is the material that moves along the bed, but is not resuspended.
- In relation to the EBSDS, having ADCP observations (upwards and downwards as proposed above) at both EBE and EBW will enable nett flux into/out of the EBSDS to be calculated (for at least the east/west direction). An important use of the data will be to determine/provide evidence to understand if a nett flux past any observational station represents advection through the EBSDS from a remote sediment source, or a flux from a source with in the EBSDS. It would be worth considering undertaking a principle component analysis of any existing hydrodynamic data for the EBSDS to enable the identification of the dominant hydrodynamic current directions and nett sediment transport pathways, and use this information to identify representative upstream and downstream observation locations for fixed site ADCP observations as described above. These 'new sites' could represent a repositioning of the proposed EBE and EBW.
- In relation to the use of altimeter on a bottom mounted frame; altimeters will measure changes in seabed height relative to the altimeter itself. If the bottom mounted frame is not anchored and fixed in a vertical plane (e.g. if the frame slowly sinks with time) then the altimeter derived erosion of deposition data will be difficult to interpret due to the moving vertical frame of reference. The bottom mounted frames that are equipped with altimeters need to be anchored/fixed in such a way that they do not sink/move vertically through the sediment. This may require driving small piles/pickets into the sediment to ensure vertical stability of the bottom mounted frames.

Please do not hesitate to contact me if you require clarification or wish to discuss further

Regards,

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Research Program Director

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