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SUBJECT	Addendum to Port Hedland Harbour - Hydrodynamic Modelling for FMG conceptual layouts report	PRIORITY	Regular

1. TASK DESCRIPTION

Worley have undertaken additional hydrodynamic modelling for the FMG conceptual layout to include updated culvert designs. Previous modelling of the FMG conceptual layout included culverts however it was assumed that they had no significant impediment to tidal flow. Culvert designs have now been completed and these have been incorporated into the model at the 4 culvert locations shown on Figure 1-1. It should be noted that the culverts have been designed to minimise impediment to tidal flow.

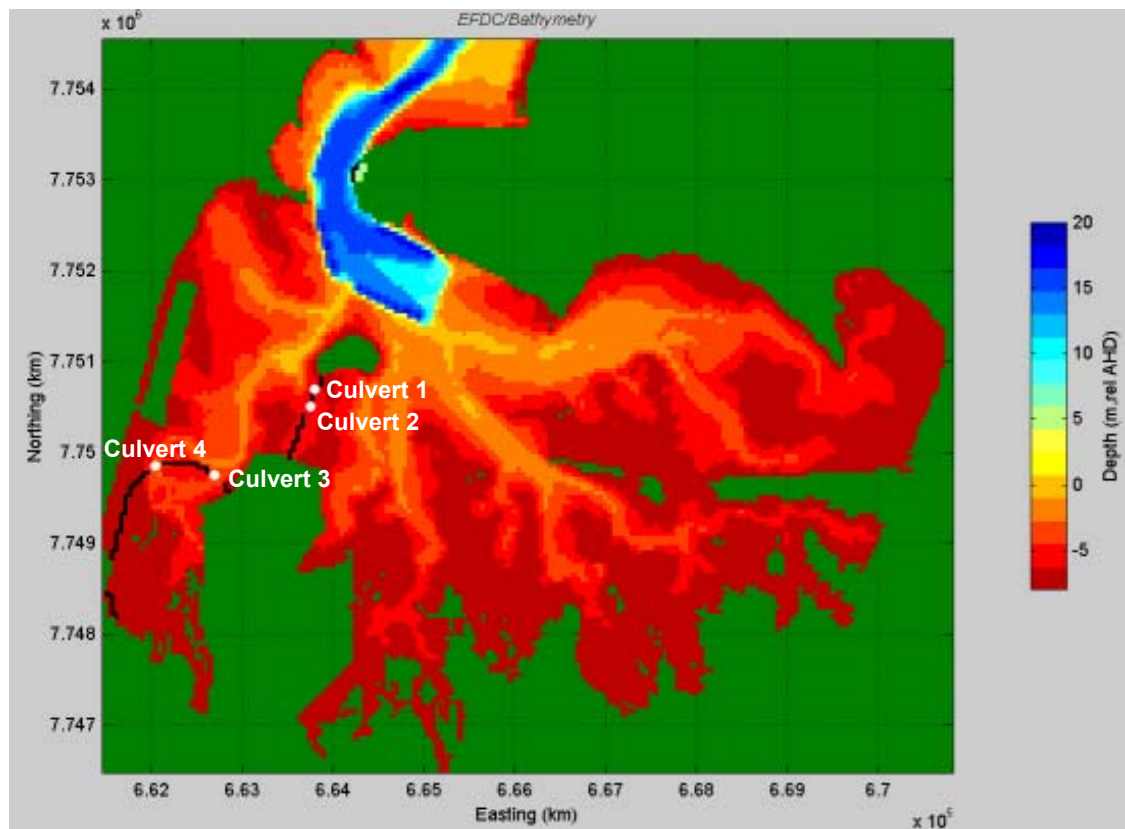


Figure 1-1: Location of culverts overlain on the model bathymetry.

2. NUMERICAL MODELLING

Numerical modelling was undertaken using the EFDC hydrodynamic model developed by John Hamrick, formerly of the Virginia Institute of Marine Science. Details of the model are given in the report, 302/07100a02 (Worley, 2004). The modelling presented herein reran the tidal case identified in previous work and the parameters established in the earlier modelling work were kept constant. For details of the input parameters see previous report 302/07100a02 (Worley, 2004).

3. ADDITIONAL SIMULATION RESULTS

3.1 Impact of FMG Proposal on Tidal Currents

The potential for the proposed developments to have deleterious flow-on effects over the wider region of Port Hedland Harbour and Mangrove areas was investigated. From the model results for the additional simulation, residual depth-averaged currents were computed and the difference between the existing and the post-FMG development scenarios was then calculated. Based on the results the impact of the culverts was localised to the immediate area around the culverts where an increase in current magnitude was evident. This was expected due to the constriction of the flow through the culverts.



3.2 Impact of FMG Proposal on Water Levels within Berth and Mangrove Areas

Submergence curves have been developed from the surface elevation output from the additional model run for 19 points within the model domain. Comparison submergence plots for each point for the existing layout simulation, the HD development simulation and the additional FMG layout simulation were developed also. The easting and northing of each point is given in Table 3-1 and the location is shown on Figure 3-1.

Table 3-1: Coordinates of points where submergence curves have been developed.

<i>Point</i>	<i>Easting (m)</i>	<i>Northing (m)</i>
1	664350	7752550
2	663350	7751650
3	663550	7751000
4	663000	7750300
5	662050	7749650
6	664700	7750850
7	664350	7750350
8	664750	7750050
9	664100	7749350
10	665100	7749050
11	665450	7750550
12	666100	7749950
13	666350	7749000
14	667150	7749300
15	665950	7751150
16	667100	7751500
17	669100	7751150
18	662400	7748850
19	662550	7749600

* All Coordinates referenced to horizontal datum GDA94.

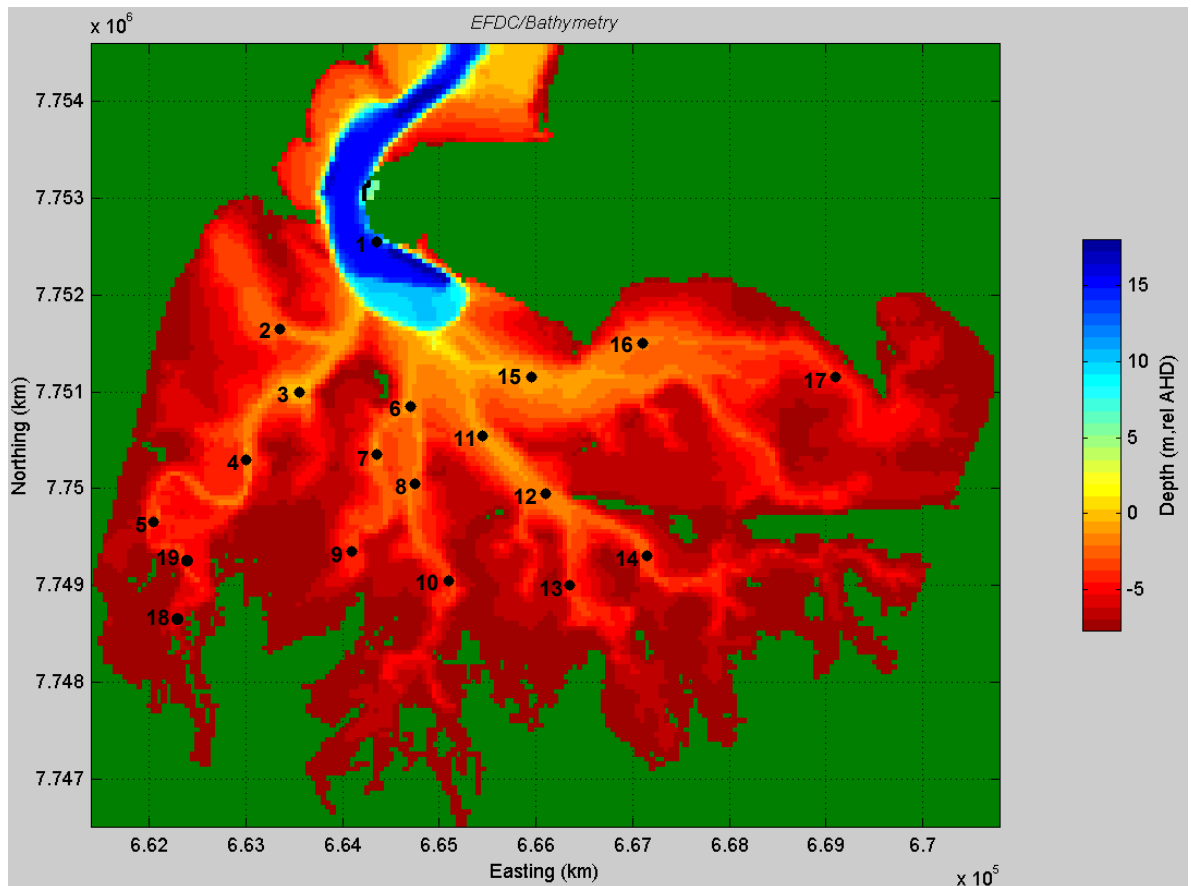
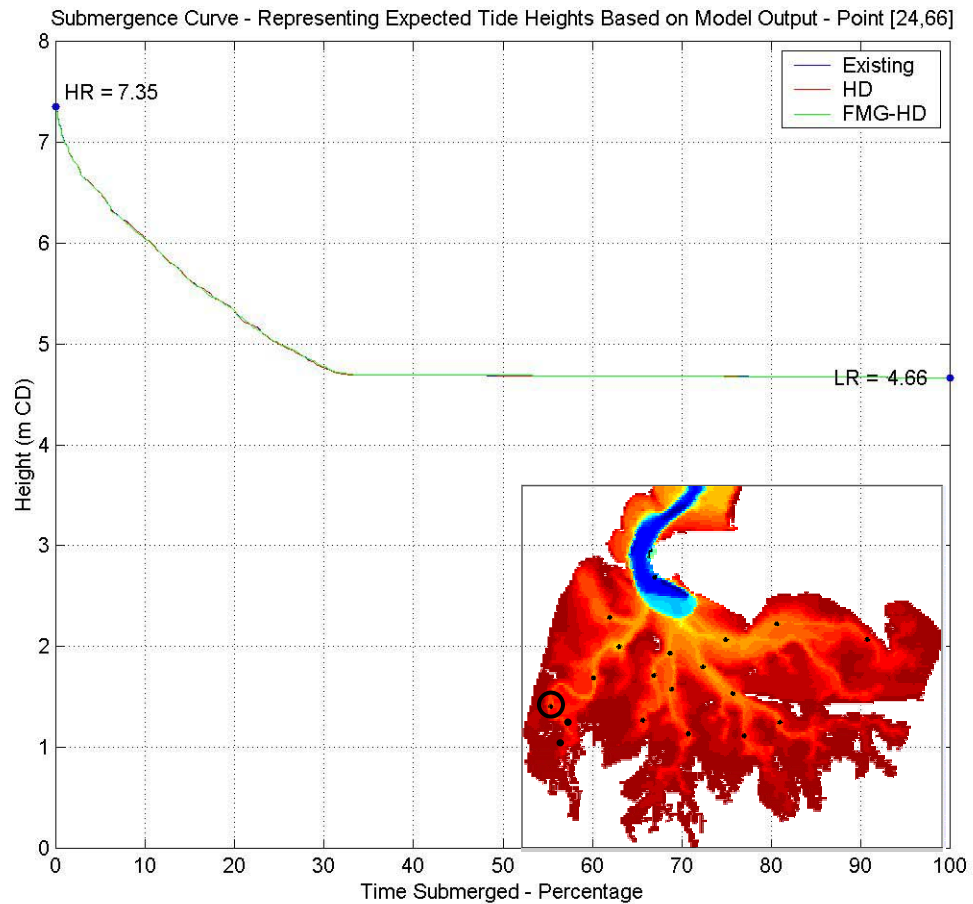


Figure 3-1: Location of points where submergence curves have been developed.

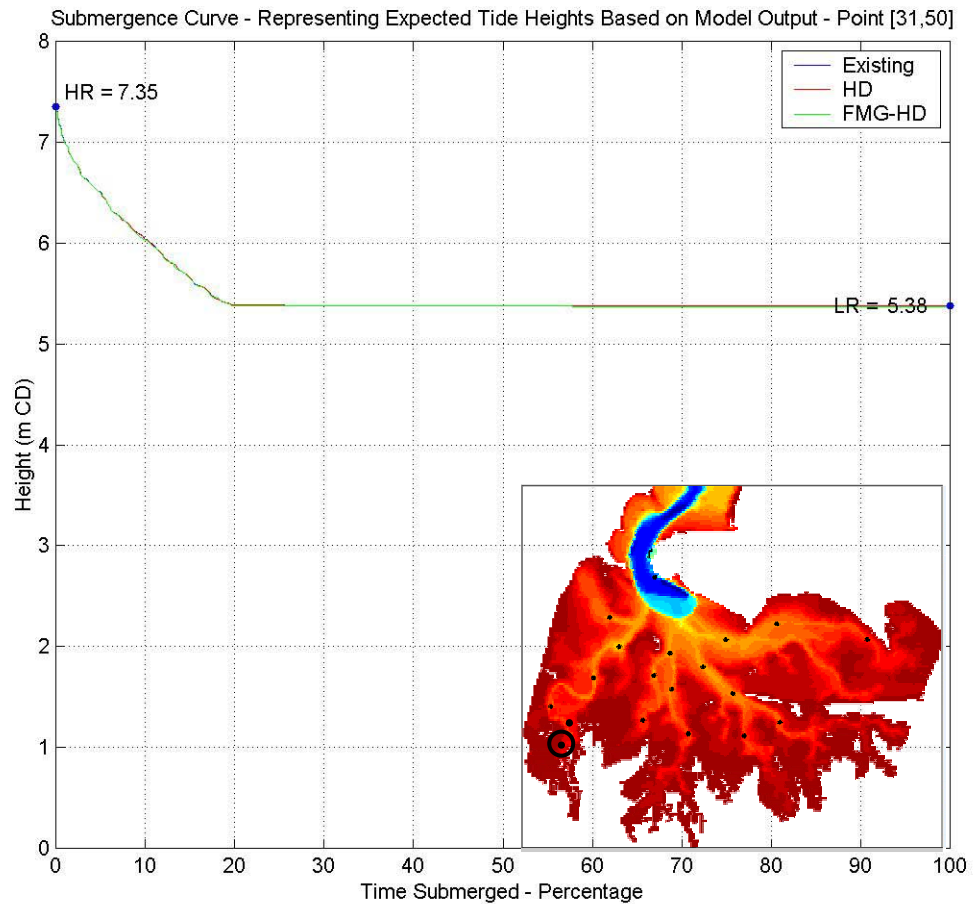
The submergence curves examine the effect of the proposed developments on water levels within Port Hedland Harbour, in particular in the inundation of the Mangrove areas. Based on the submergence curves for the additional run the changes to water levels within the mangrove areas are small with insignificant change to MSL, MHWS and MLWS. The changes were in the order of 1 cm with a maximum of 2cm. Based on the small magnitude of these changes the inundation of the mangroves should not change significantly. Comparison submergence curves for points 5 and 19 are presented in Figures3-2 and 3-3. These points are located just before culvert location 4 and beyond culvert location 4 in the upper reaches of the tidal creek. They illustrate the minimal change that occurs within the mangrove areas. Submergence curves for all 19 points are available on request.

Changes to the water level in the berth areas were also insignificant and should have little effect on the operability of the berths.



Time Submerged (%)	1	2	5	10	25	50	75	90	95	98	99
Existing WL (m CD)	7.01	6.82	6.5	6.04	5	4.69	4.68	4.67	4.67	4.67	4.66
HD WL (m CD)	7	6.81	6.5	6.04	5	4.69	4.68	4.67	4.67	4.67	4.67
FMG-HD WL (m CD)	7.01	6.81	6.5	6.04	5	4.69	4.68	4.67	4.67	4.67	4.67

Figure 3-2: Comparison Submergence curve for existing layout, HD proposed layout and FMG proposed layout simulations – Point 5.



Time Submerged (%)	1	2	5	10	25	50	75	90	95	98	99
Existing WL (m CD)	7.01	6.82	6.5	6.03	5.38	5.38	5.38	5.38	5.38	5.38	5.38
HD WL (m CD)	7	6.81	6.5	6.03	5.38	5.38	5.38	5.38	5.38	5.38	5.38
FMG-HD WL (m CD)	7.01	6.81	6.5	6.03	5.38	5.38	5.37	5.37	5.37	5.37	5.37

Figure 3-3: Comparison Submergence curve for existing layout, HD proposed layout and FMG proposed layout simulations – Point 19.



Time-series of surface elevations were also examined at the 19 points and at the culvert locations. As with the submergence curves the changes in water levels were relatively small in the order of 1 to 2 cm. A slight lag of the order of 2-3 minutes was noted near the culverts this may be due to the constriction of the flow through the culverts. A time series for one tidal cycle is presented in Figure 3-4 to illustrate this lag. As the lag and the change in water level between simulations is relatively small it is anticipated that the FMG proposed layout will have minimal impact on the inundation of the mangroves.

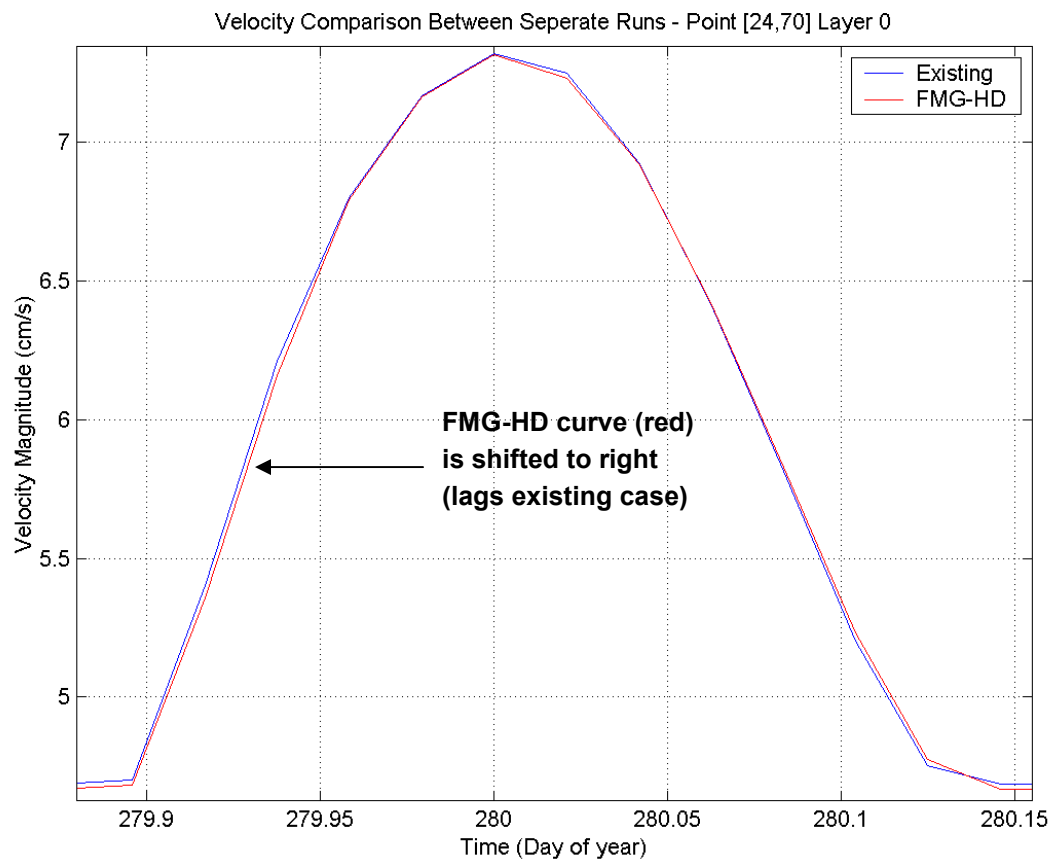


Figure 3-4: Half a tidal cycle at culvert location 4 for the existing layout simulation and the FMG conceptual layout simulation.

4. CONCLUSION

Overall the comparative modelling predicts that the impacts of the inclusion of the designed culverts across the tidal creeks will be localised to the area immediately surrounding the culvert locations, with minimal impact in the broader creek and mangrove regions.