

**APPENDIX 3D COMPARISON OF OBSERVED WATER QUALITY AGAINST
TIME SERIES PLOTS OF PREDICTED WATER QUALITY AT
EPD WATER QUALITY MONITORING STATIONS NEAR
PROJECT SITE**

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Source:

Observed Data

EPD Marine Water Quality Monitoring Stations MM5, MM6, MM7, 2011 to 2020.

Modelled Data

Time series prediction of Delft3D WAQ model (STKDD) at the same locations for 2016.

Approach

Average of observed data for each month of the 10 most recent years were used for comparison to smooth out inter-annual variation of meteorological and hydrological conditions which has not been taken into account in the Delft3D modelling scenario.

Discussion

Model prediction for key water quality parameters for this Project, namely, dissolved oxygen, 5-day biochemical oxygen demand, total inorganic nitrogen, orthophosphate phosphorus, suspended solids and chlorophyll-a, would be discussed in turn in the subsequent sections.

(a) Dissolved Oxygen

Predicted dissolved oxygen levels matched quite well with the observed data, with a small overall underestimation. Notable level of stratification observed in the region in wet season was reproduced in the model.

(b) Biochemical Oxygen Demand

Predicted biochemical oxygen demand were similar to the observed level at the nearby EPD monitoring stations with small underestimation. Such small underestimation is not considered to be of particular concern that could affect the conclusion of the modelling exercise given both the observed and predicted levels were significantly below that of the corresponding assessment criterion of 10 mg/L.

(c) Total Inorganic Nitrogen

The predicted level of total inorganic nitrogen were generally higher than that of the observed levels at the nearby EPD monitoring stations as a results of conservative assumptions adopted for estimation of pollution loading. The model was able to reproduce in the wet season the stratification as well as elevated levels of total inorganic nitrogen.

(d) Orthophosphate Phosphorus

Similar to the case of total inorganic nitrogen, the model prediction was generally slightly above the observed data (because of conservative pollution load estimation) and was able to reproduce stratification and slightly elevated levels in the wet season.

(e) Suspended Solids

The predicted levels of suspended solids matched quite well with the observed data, with a small overall underestimation.

(f) Chlorophyll-a

The predicted levels of chlorophyll-a were generally higher than the observed data as a result of conservative overestimation of nitrogenous and phosphorus nutrients discussed above. Nevertheless, the elevated levels during wet season as well as the stratification were both reproduced in the model.

Conclusion

The water quality model was able to reproduce key water quality characteristics including seasonal changes and stratification, as well as suitably accurate prediction of certain key water quality parameters. Note that the effect of conservative overestimation of pollution load, particularly for nitrogenous and phosphorus nutrients have been reflected in as the overestimated levels in the model, as well as an over-abundant of chlorophyll-a in the area. Such overestimation is deemed conservative in term of assessment and be suitable for the purpose of an environmental impact assessment study. It is therefore concluded this water quality model of STKDD suitable for this Study.

Parameters	Location	Plot
Dissolved Oxygen	MM5	
	MM6	
	MM7	

Parameters	Location	Plot
	MM17	
5-day Biochemical Oxygen Demand	MM5	
	MM6	
	MM7	

Parameters	Location	Plot
	MM17	
Total Inorganic Nitrogen	MM5	
	MM6	
	MM7	

Parameters	Location	Plot
	MM17	
Orthophosphate Phosphorus	MM5	
	MM6	
	MM7	

Parameters	Location	Plot
	MM17	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
Suspended Solids	MM5	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
	MM6	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
	MM7	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>

Parameters	Location	Plot
	MM17	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
Chlorophyll-a	MM5	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
	MM6	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>
	MM7	<p>Concentration (mg/L)</p> <p>Date (MM/DD)</p> <p>— Modelled-Surface — Modelled-Middle — Modelled-Bottom ○ Observed-Surface × Observed-Middle + Observed-Bottom</p>

