BMT WBM

Memorandum

From:	Dr Michael Barry / Fanny Houdré	To:	Randall Byram
Date:	13 February 2009	CC:	ERM – Chris Jack
Subject:	Preliminary Hydrodynamic Assessment of Fisherman's Landing Reclamations		

Dear Randall

This memo reports the preliminary assessment of the hydrodynamic impacts associated with various filling and reclamation options in and around Fishermans Landing, Port Curtis. This assessment is in response to item 5 of your email of Tuesday, February 03, 2009 5:05 PM to Tony McAlister.

Preliminary flushing assessments (i.e. advection dispersion assessments) corresponding to the hydrodynamic simulations presented here will be reported late next week, as promised.

We note that both the hydrodynamic and flushing assessments forming item 5 in your email are preliminary in nature and are intended to provide input to an initial scoping study addressing the likely impacts of various reclamation options. It is understood that a subsequent tranche of work will be undertaken at a later date which will be much more detailed in nature, and will most likely rework some of the currently considered scenarios at supplementary stage. These follow up works will also include full sedimentation analyses (and the like) for a targeted number of dredge and reclamation scenarios. To some extent, that subsequent study scope will be guided by the outcomes of this initial study. The detailed scope of the subsequent study is yet to be determined.

1. Model Configuration

The existing two-dimensional (2D) hydrodynamic model of Port Curtis was used to undertake this assessment. BMT WBM has developed and repeatedly refined and improved calibration and model performance for many years.

A total of 4 different scenarios were simulated as instructed by QGC, as follows:

1 "QGC" Scenario.

- the proposed swing basins (both QGC and Santos) dredged as per the layout provided late last year;
- the proposed MOF (also as per the layout provided late last year);
- the proposed bridge with abutments; and
- the corresponding approach road from the south west.

It was subsequently used as the reference case for the assessment of hydrodynamic impacts of the various reclamation options;

2 "FL153"

- "QGC" Scenario plus Fishermans Landing reclamation FL153;

3 "FL1b"

- "QGC" Scenario plus Fishermans Landing reclamation FL1b; and

4 “FL2”

- “QGC” Scenario plus Fishermans Landing reclamation FL2;

Scenarios 2 to 4 correspond to the reclamation data provided by QGC to BMT WBM on 4/02/2009. The boundaries of these reclamations are shown below.

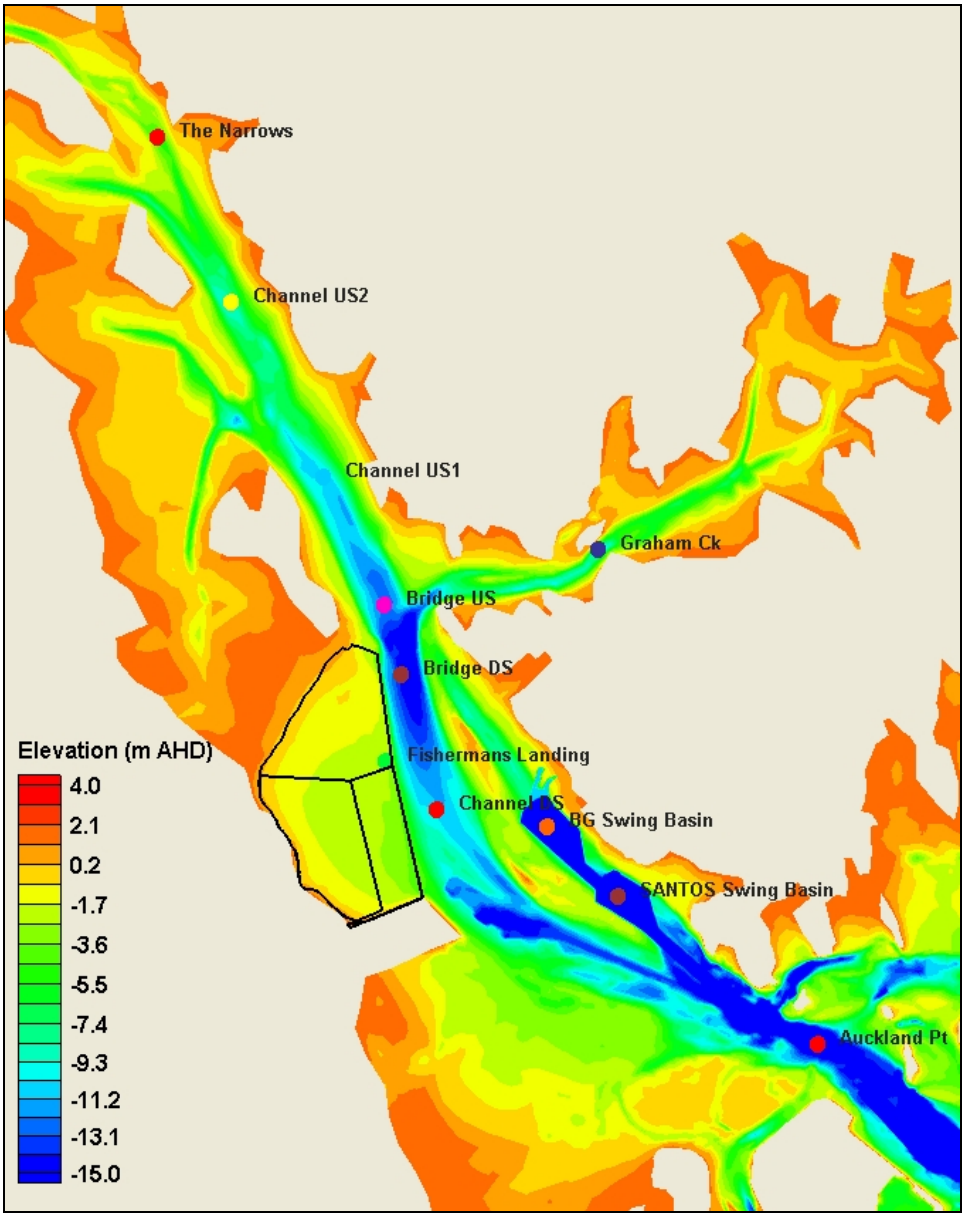

Figure 1 Results Extraction Locations

In all of scenarios 2 to 4, the model was reconfigured by inactivating relevant cells within the model mesh (as proposed), rather than refining or realigning model meshes and elements along the proposed reclamation areas. Due to their preliminary nature, none of these scenarios include potential dredging at the proposed Fishermans Landing berths or widening/deepening of Targinie Channel. They do include the proposed Santos and QGC approach channels and swing basins, as per the complementary EIS documents to be provided next week.

The simulations described above were conducted for a 14 day representative neap-spring tidal cycle, and the model results were interrogated in order to determine relevant impacts of the proposed reclamation options on tidal hydraulics, relative to the reference case (“QGC”). These impacts are summarised and discussed in the following sections.

2. Results

2.1 Tidal Water Levels

Water levels results were extracted at the locations shown in Figure 1. Timeseries of water levels predicted downstream of the proposed bridge for each scenario are reported in Figure 2 as an example.

An analysis of low and high water behaviours was undertaken for each scenario. Maximum change in low and high waters at the selected locations are predicted to be in the order of 5cm or less, with low water changes being the greatest. The maximum change is observed for at the Narrows for reclamation option FL2, with low water surface elevations being increased by 4.5cm compared to the "QGC" reference case. For this specific low tide, other reclamation options impacts are as follows:

- FL2: low tide increased by 4.5cm (i.e. from -1.733 m AHD to -1.688 m AHD);
- FL153: low tide increased by 3.5cm (i.e. from -1.733 m AHD to -1.698 m AHD); and
- FL1b: low tide increased by 2.8cm (i.e. from -1.733 m AHD to -1.705 m AHD).

A half hour time shift in phasing of tides was also observed between the reference case and the various reclamation options at the high and low tide times. This phase shift was however not regular. The model timestep, however, is half an hour, so phase shifts of this order and smaller are difficult to resolve.

Overall changes in water surface elevations between the various reclamation cases and the "QGC" reference case are maximal during mid-ebb tides (rather than at low or high water). Differences of up to 11cm are predicted within the main channel northwest of the QGC swing basin for example. However, these are largely due to the phase shift described previously. Figure 3 shows an example of this change in water surface elevation.

All tidal ranges are reduced by the various reclamation options, with low waters being higher and high waters being lower than the "QGC" case. Table 1 below summarises the % change in tidal range for a spring tide at all extraction locations, relative to the "QGC" scenario. The spring tide range is reduced by up to 1% within the main channel to the northwest of the proposed QGC swing basin for the FL2 reclamation option.

Similarly, Table 2 presents those same percentages as calculated over a neap tide. The neap tide range is reduced by up to 1.3% up in the Narrows for the FL2 reclamation option. Option FL153 is predicted to have the least impact on tidal water levels at the selected extraction locations.

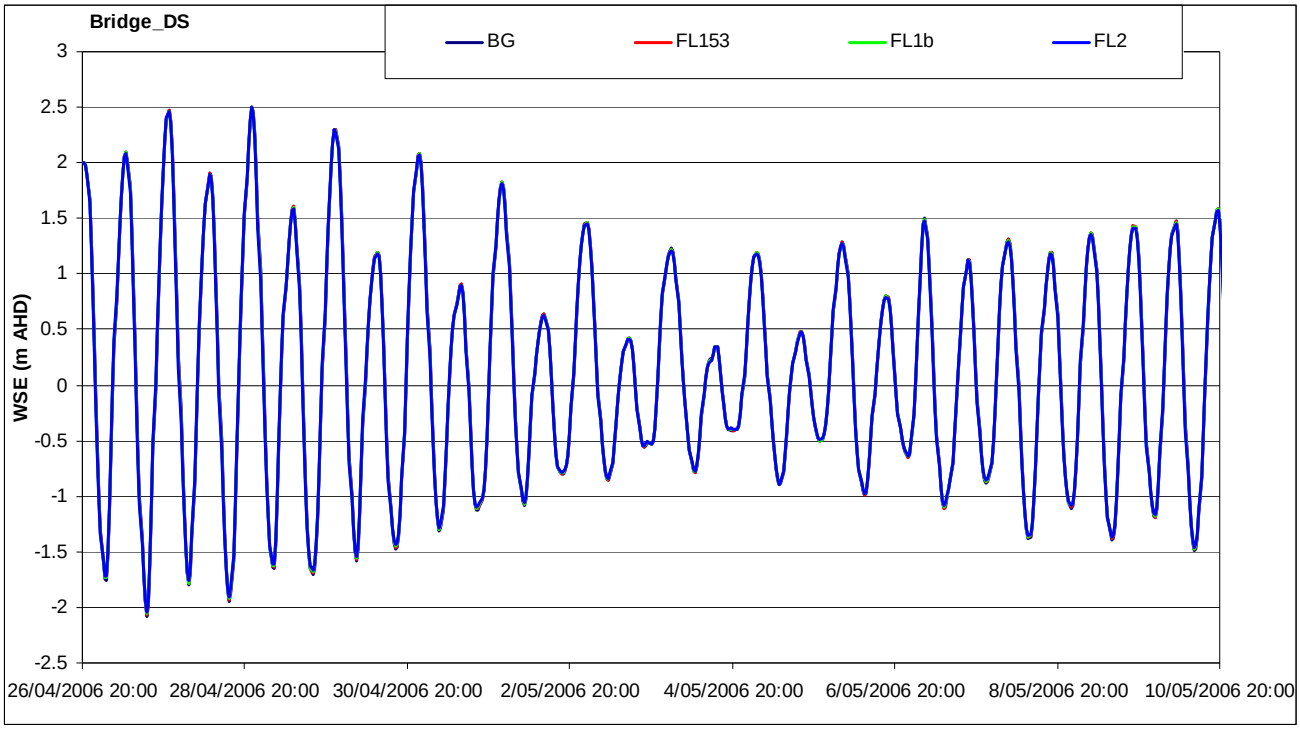

Figure 2 Predicted WSE Downstream Bridge

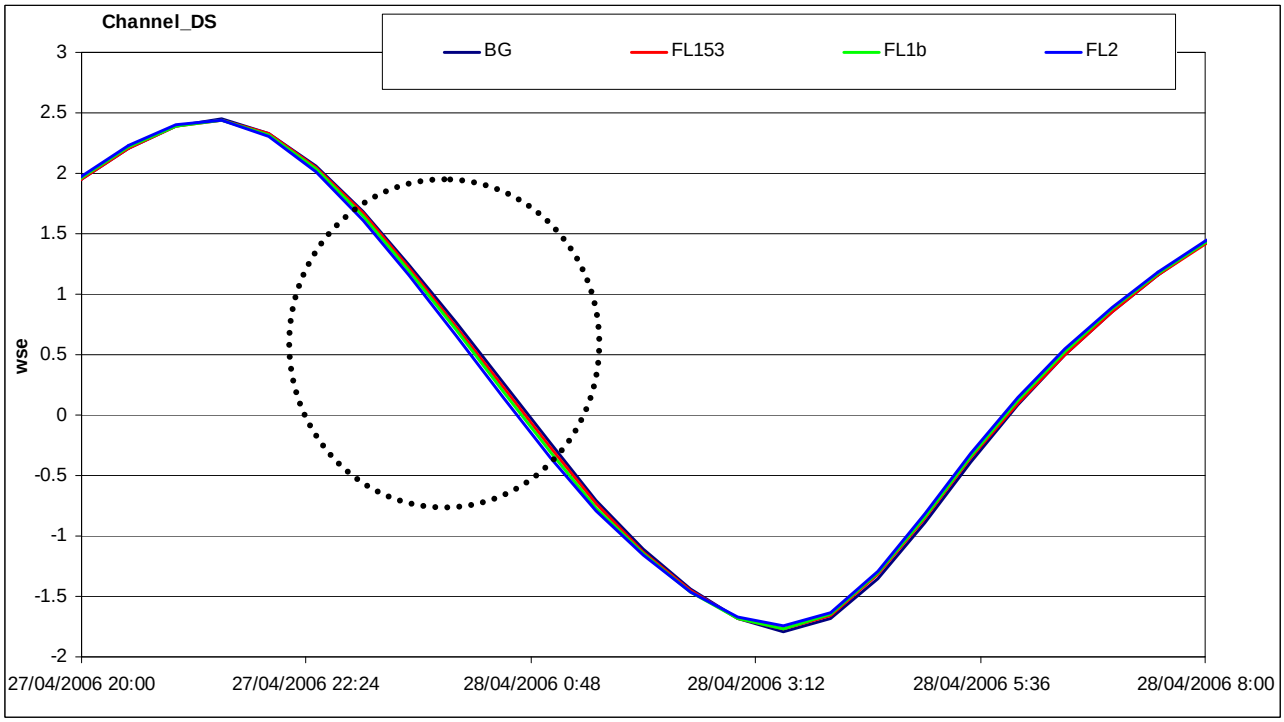

Figure 3 Timeseries of WSE within the Main Channel

Table 1 Percentage Change in Tidal Range – Spring Tide. Maximum Change Highlighted

	FL153	FL1b	FL2
Narrows	-0.2%	-0.5%	-0.9%
ChannelUS2	-0.3%	-0.5%	-0.8%
ChannelUS1	-0.3%	-0.5%	-0.8%
BdgUS	-0.3%	-0.5%	-0.9%
GrahamCk	-0.3%	-0.5%	-0.8%
QGCBasin	-0.4%	-0.6%	-0.9%
BdgDS	-0.3%	-0.5%	-0.9%
ChannelDS	-0.4%	-0.7%	**-1.0%**
SANTOSBasin	-0.3%	-0.6%	-0.9%
AucklandPt	-0.2%	-0.4%	-0.5%

Table 2 Percentage Change in Tidal Range – Neap Tide. Maximum Change Highlighted

	FL153	FL1b	FL2
Narrows	-0.2%	-0.7%	**-1.3%**
ChannelUS2	-0.1%	-0.5%	-1.1%
ChannelUS1	-0.1%	-0.5%	-1.0%
BdgUS	-0.1%	-0.5%	-1.1%
GrahamCk	-0.1%	-0.4%	-0.9%
QGCBasin	-0.2%	-0.6%	-1.0%
BdgDS	-0.1%	-0.5%	-1.1%
ChannelDS	-0.3%	-0.6%	-1.2%
SANTOSBasin	-0.2%	-0.5%	-1.0%
AucklandPt	-0.2%	-0.4%	-0.8%

2.2 Tidal Velocities

Contour plots of predicted velocity magnitude impacts were created respectively for a snapshot of typical spring ebb and spring flood tide conditions. They are presented in Figure 4 to Figure 9. Note that velocity directions for the reclamation cases have also been plotted on those figures. These directions are absolute, not differences.

The impacts vary in space and intensity with time. In particular, the greatest impacts around Fisherman's Landing and the main channel areas are not co-temporal. To illustrate this, two different plots are presented for all scenarios, which correspond to two different times within the tidal cycle. The times presented are not necessarily the same for all scenarios, but have been chosen to illustrate the greatest impacts near the reclamations and channels.

General patterns show decreases in velocity magnitudes downstream (south-east) of the Fishermans Landing reclamation site(s), within the main channel. Clearly, velocities induced by the proposed channels within various reclamation options (those that involve islands) are greater than those at the same locations in the "QGC" scenario, due to channelling of tidal flows.

Similarly, some significant residual velocities around the northern end of the FL153 scenario reclamation area are predicted. These are most likely due to the alteration of the flow path required to fill (and drain) the tidal storage behind the reclamation area. In the "QGC" case this filling (or draining) was achieved primarily by relatively low flow velocities across the intertidal areas, whereas in scenario FL153, this filling (or draining) occurs by flow around the northern end of the reclamation area and back southwards again, generating strong currents around the reclamation area.

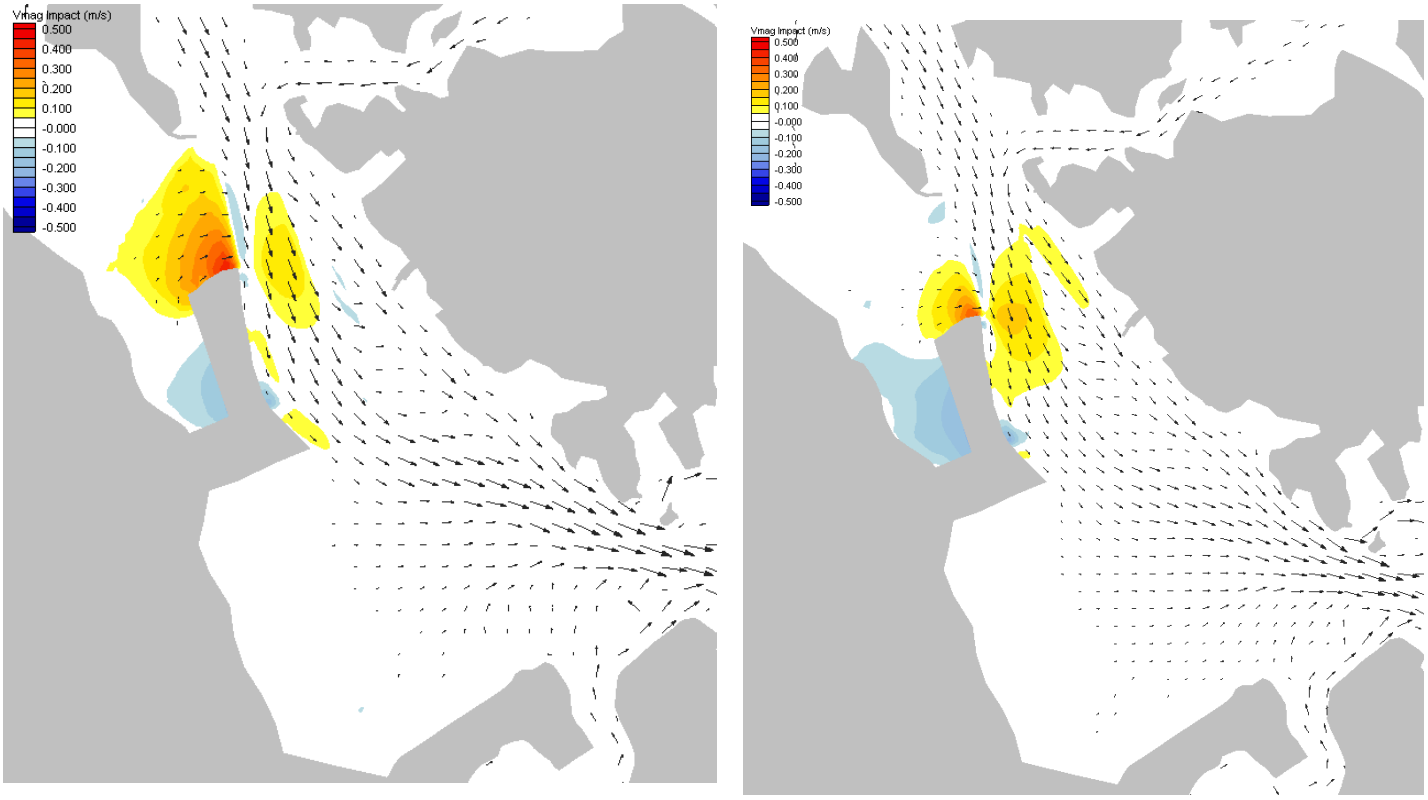

Figure 4 Velocity Magnitude Impacts – FL153 – Ebb Tide

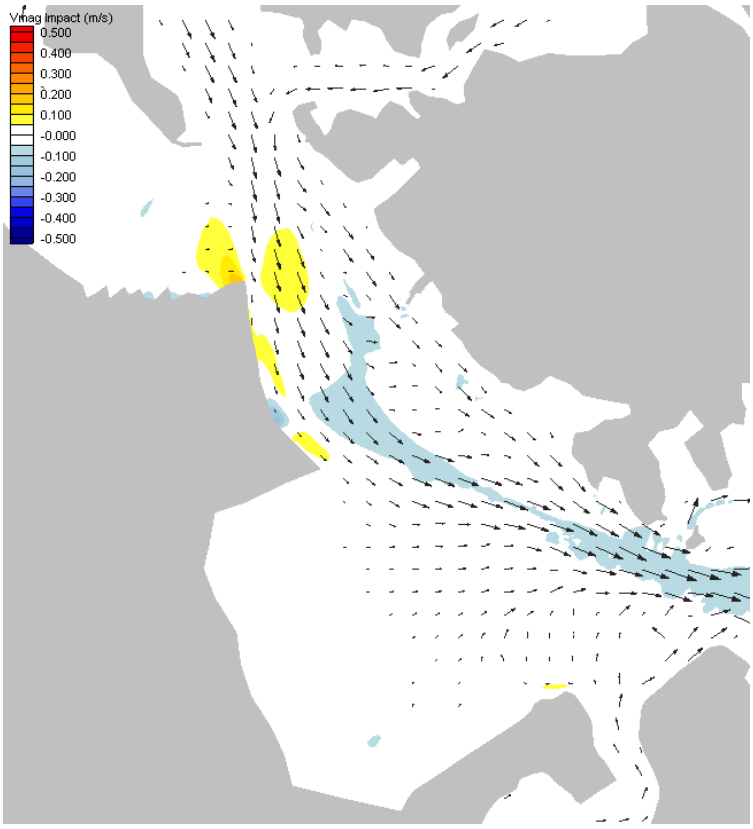

Figure 5 Velocity Magnitude Impacts – FL1b – Ebb Tide

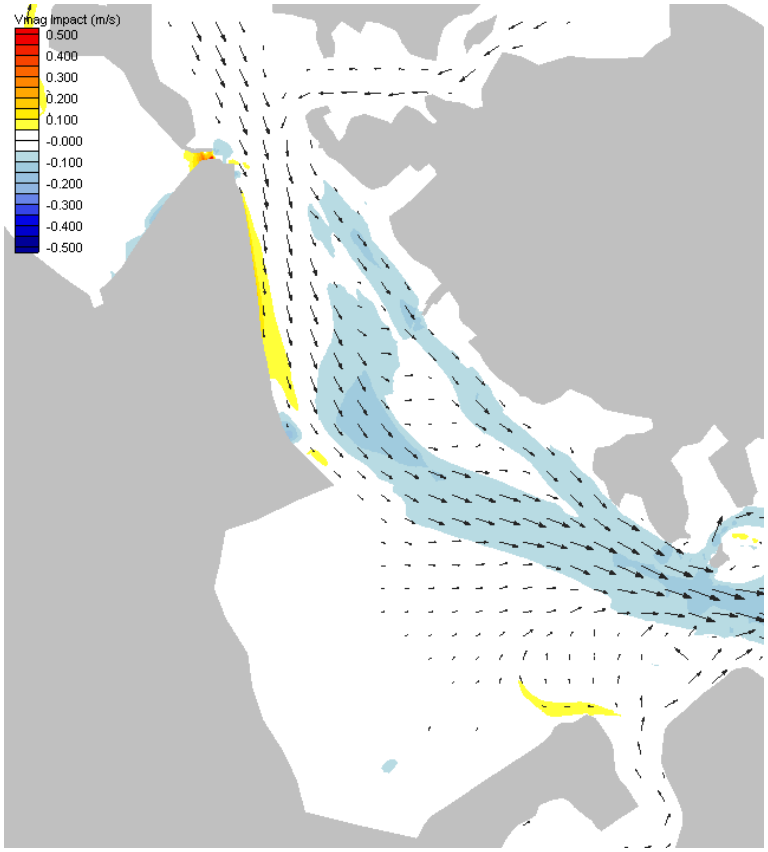

Figure 6 Velocity Magnitude Impacts – FL2 – Ebb Tide

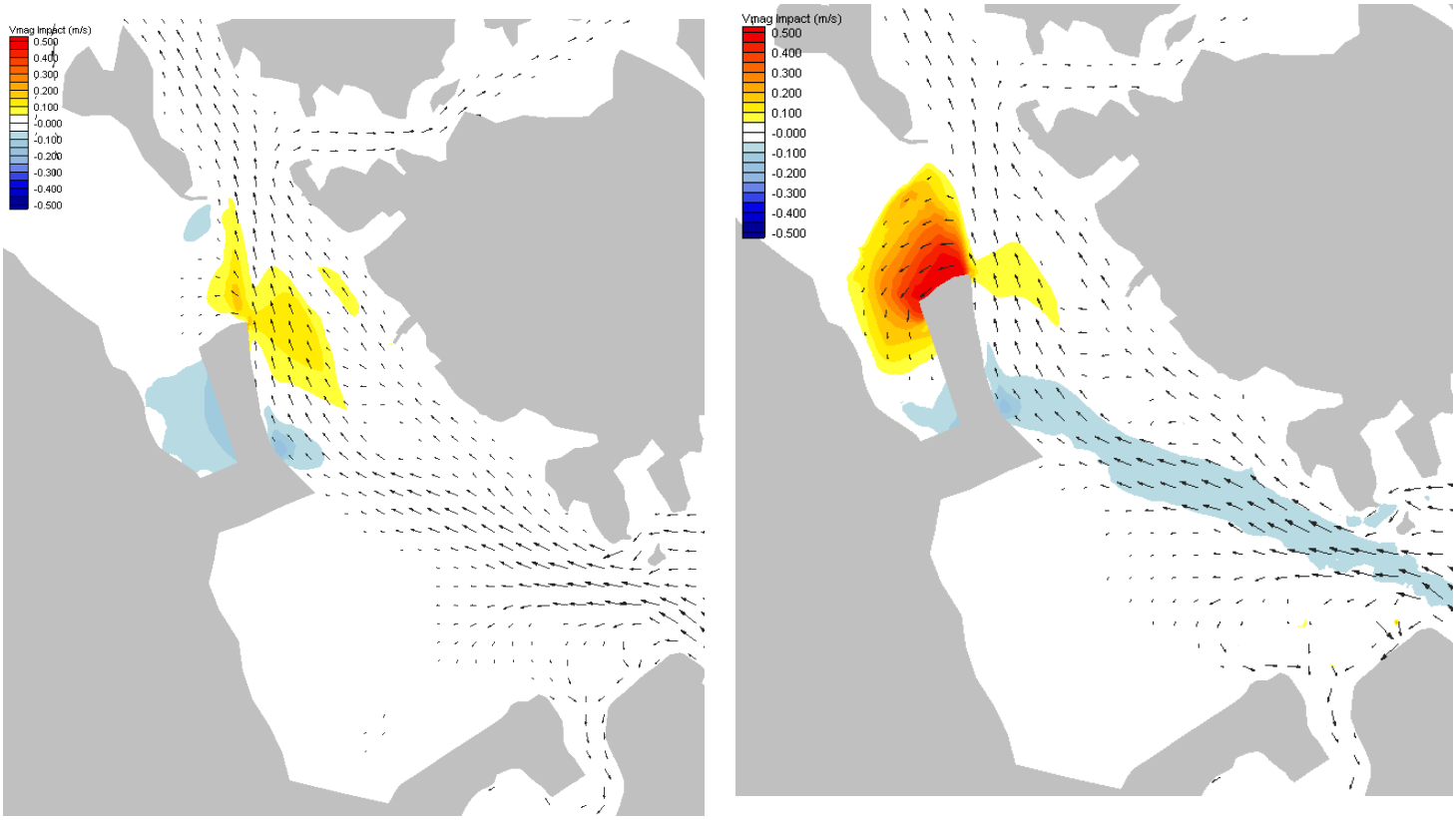

Figure 7 Velocity Magnitude Impacts – FL153 – Flood Tide

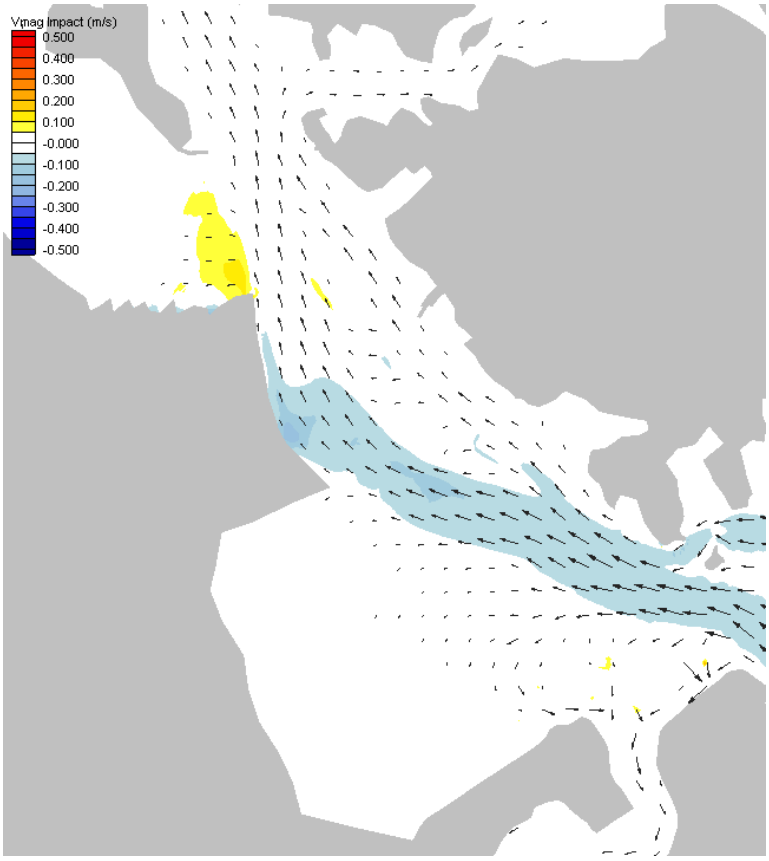

Figure 8 Velocity Magnitude Impacts – FL1b – Flood Tide

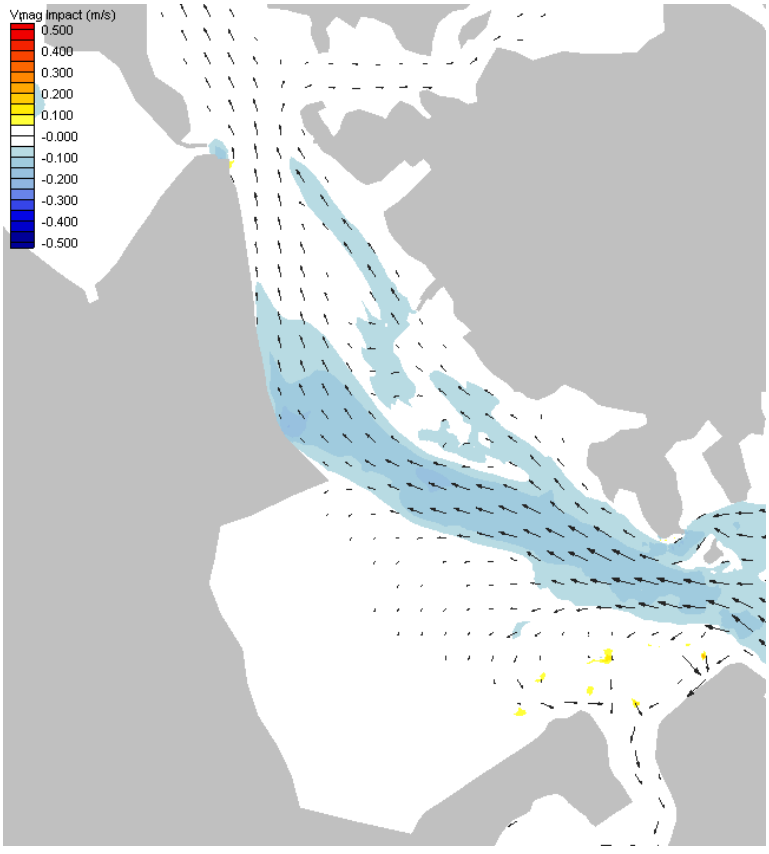

Figure 9 Velocity Magnitude Impacts – FL2 – Flood Tide

A percentile analysis was also performed on velocity magnitudes for all scenarios. Figure 10 to Figure 14 present the results of this analysis at selected timeseries extraction locations within Port Curtis. The impact of the various reclamation options (relative to the reference case) are negligible upstream (north) of the proposed bridge. Within the QGC and Santos swing basins, the occurrence of velocity magnitudes greater than 0.20m/s is predicted to be increased by approximately 4 to 6%, the maximum change being predicted for reclamation FL2.

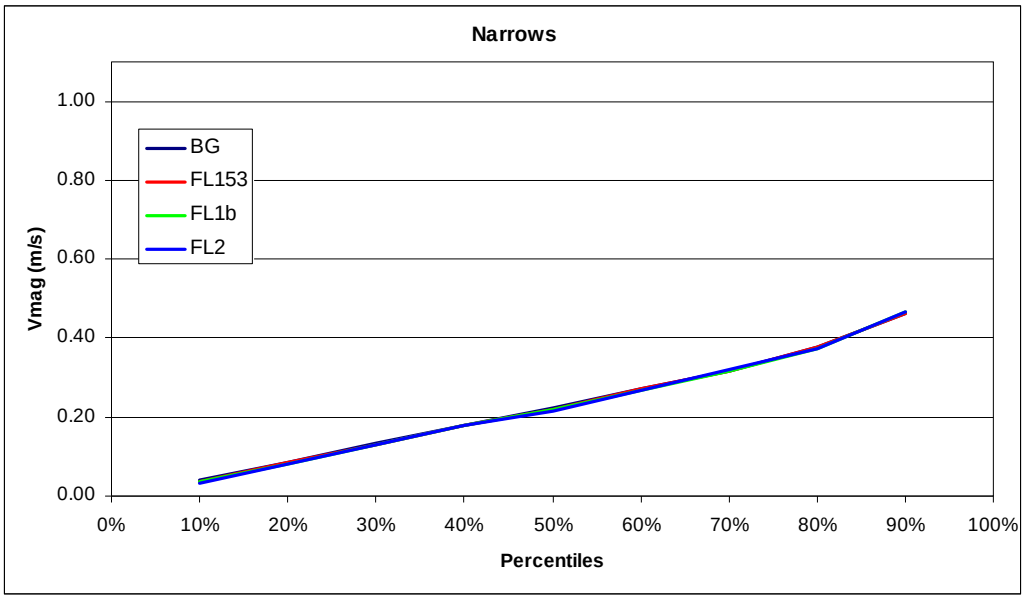

Figure 10 Velocity Magnitude Percentiles – The Narrows

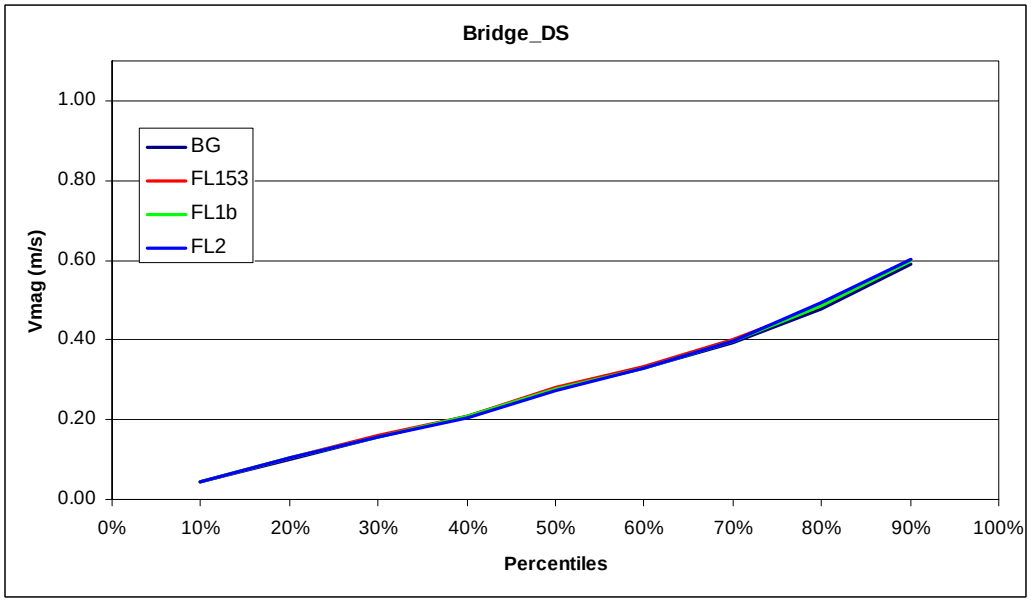

Figure 11 Velocity Magnitude Percentiles – Downstream of Bridge

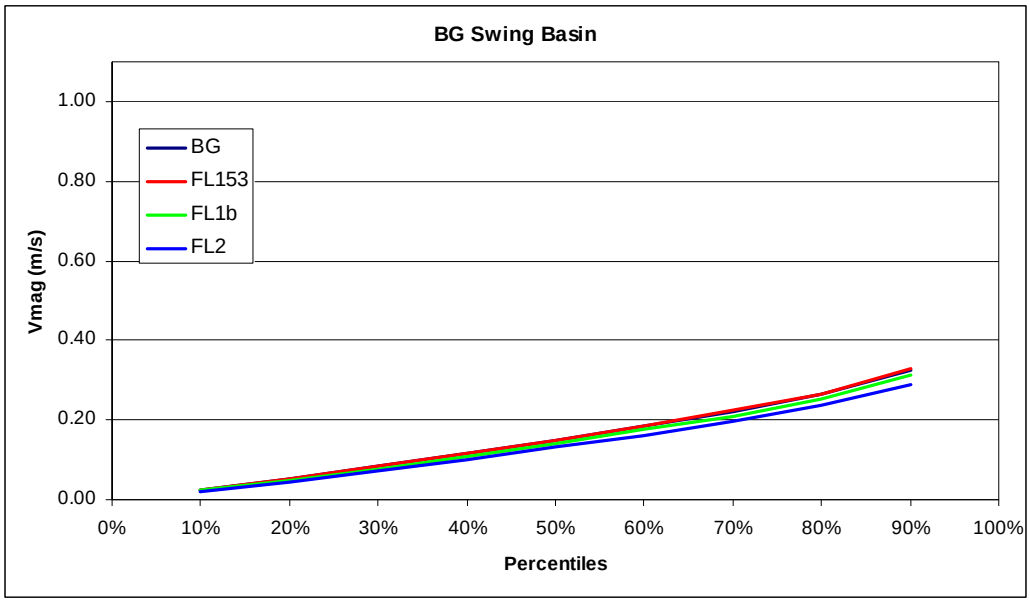

Figure 12 Velocity Magnitude Percentiles – QGC Swing Basin

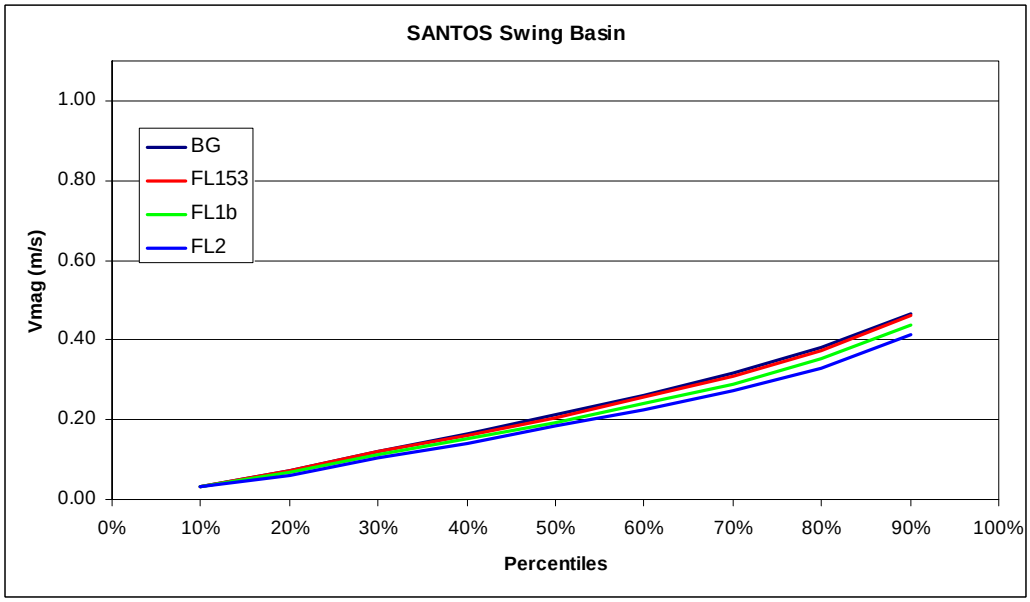

Figure 13 Velocity Magnitude Percentiles – SANTOS Swing Basin

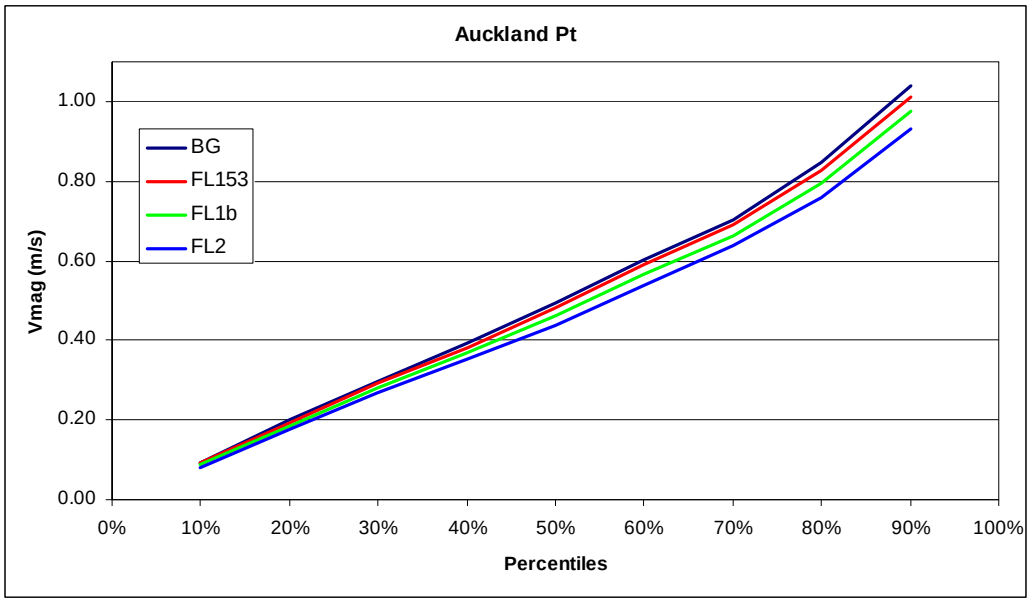

Figure 14 Velocity Magnitude Percentiles – Auckland Point

2.1 Tidal Flows

Flows through Port Curtis were assessed for each scenario along four profiles, as shown in Figure 15.

Table 3 presents the percentage change in maximum flow rate predicted (over the entire simulation period) along these profiles for each reclamation option, compared to the reference case. Increases of up to 25% are predicted along the Fishermans Landing profile for option FL153. These changes in maximum flow propagate upstream into the Narrows, but with a reduced influence. These increases are dominated by the induced circulations around the northern end of the reclamation. Decreases of up to 20% are predicted along the QGC swing basin profile for scenario FL2, consistent with a reduced tidal prism and the reduced velocities presented earlier.

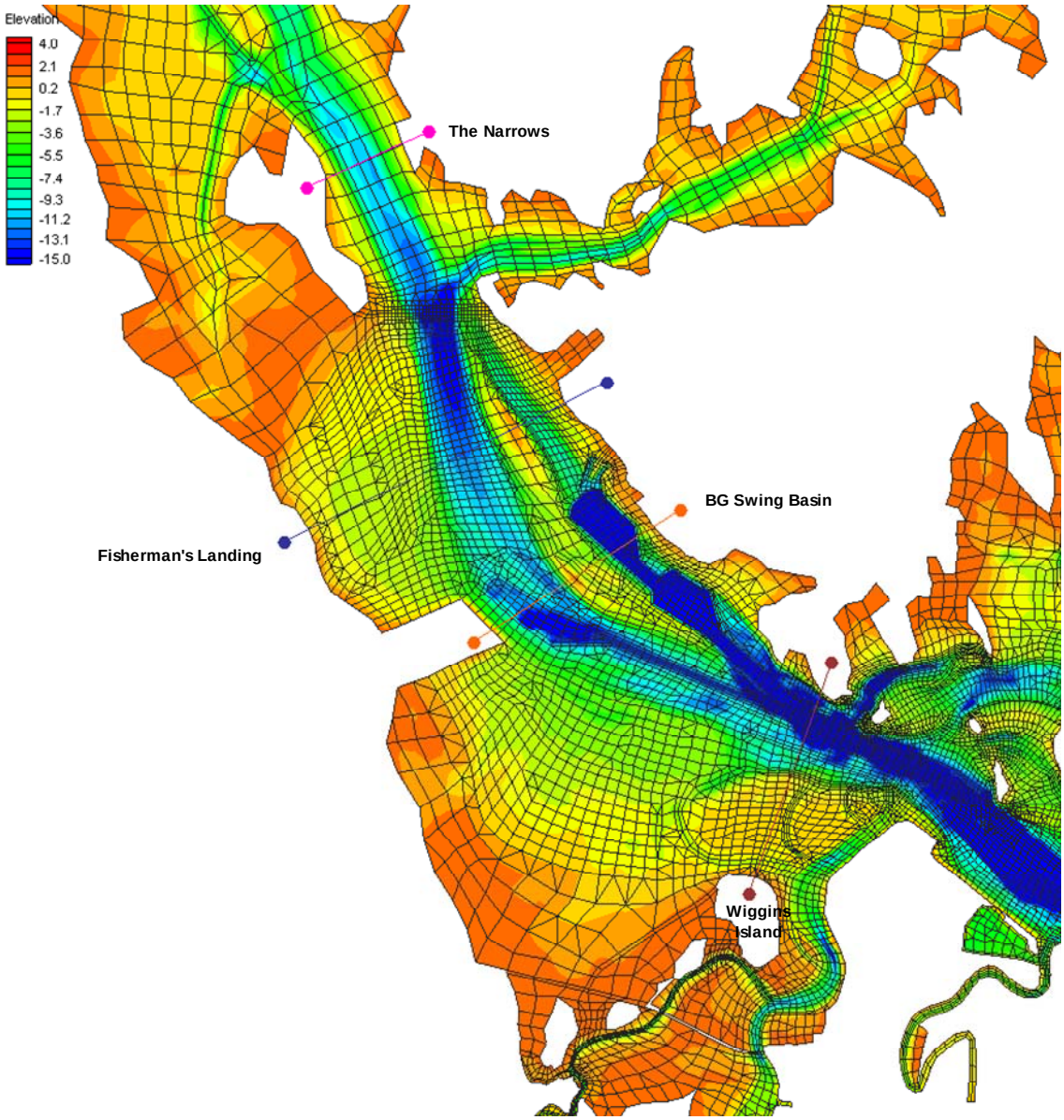

Figure 15 Flows Extraction Profiles

Table 3 Percentage Change in Maximum Flow

	Narrows	FL	QGC	Wiggins
FL153	1%	25%	-4%	-2%
FL1b	3%	16%	-10%	-6%
FL2	5%	0%	-20%	-13%

It is noted that the Fishermans Landing transect is directly affected by the proposed filling and reclamation for each option. In particular, option FL2 shows a 0% change in flow rates for this transect. However, all the flow has to transit through a reduced section (by nearly 50% in width, not area) given the proposed filling of the entire Fishermans Landing area.

Timeseries of flows through the selected profiles are also reported on Figure 16 to Figure 19 for each scenario. The major changes in flow rates are predicted at peak ebb and flood tides, and this is demonstrated in Figure 20, which is temporal zoom of predicted flow data through the Fishermans Landing transect.

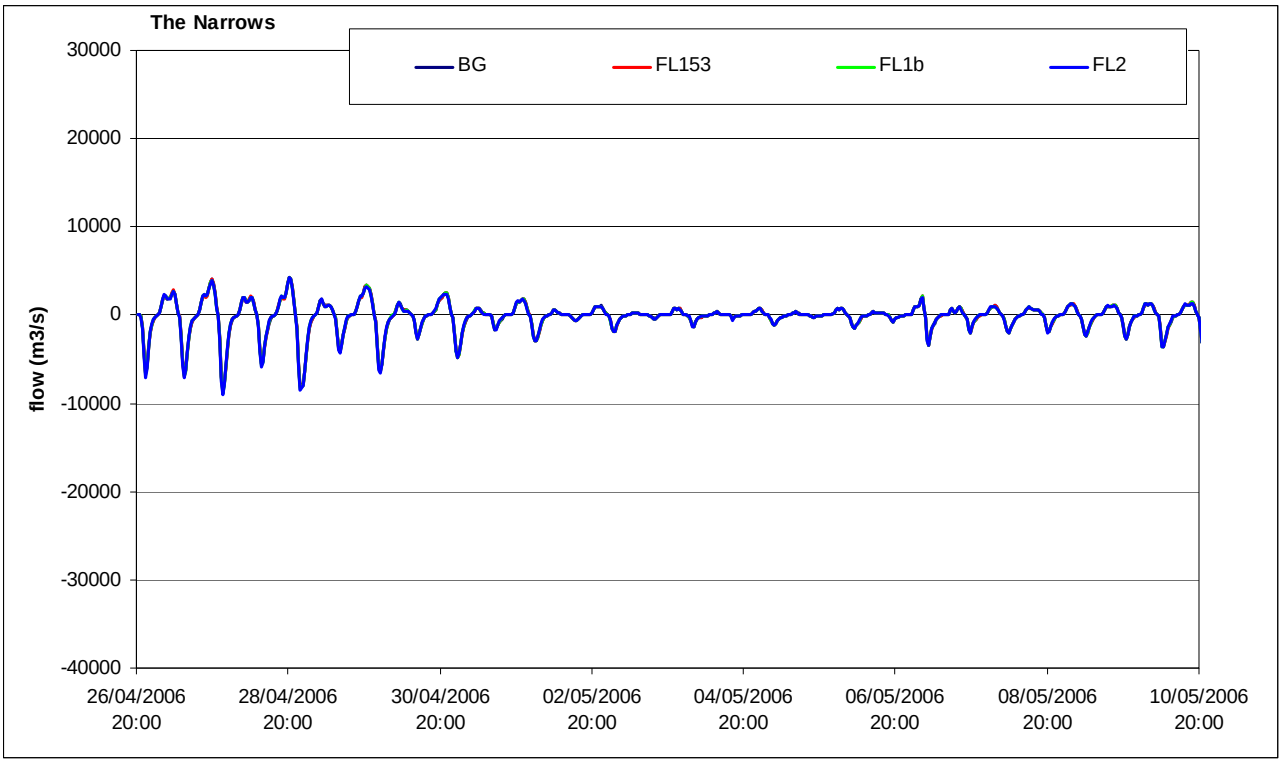

Figure 16 Flow Timeseries Through The Narrows Profile

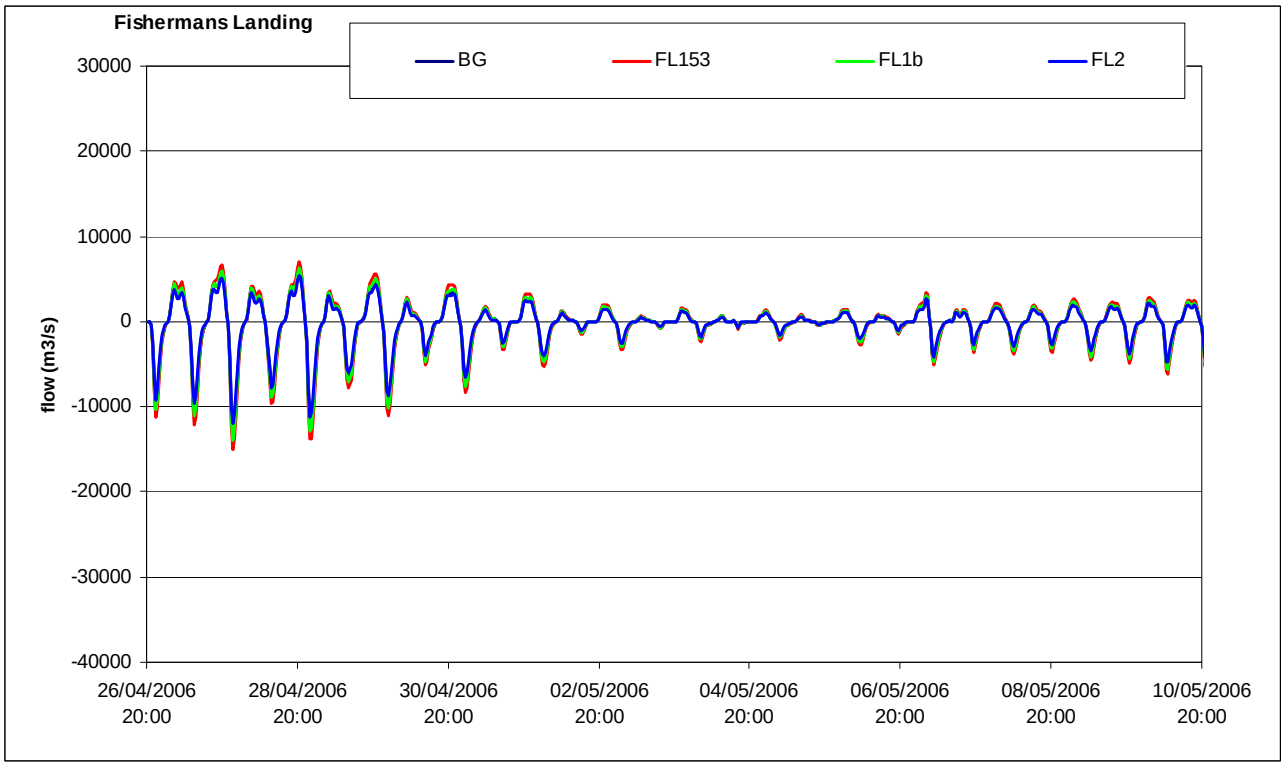

Figure 17 Flow Timeseries Through Fishermans Landing Profile

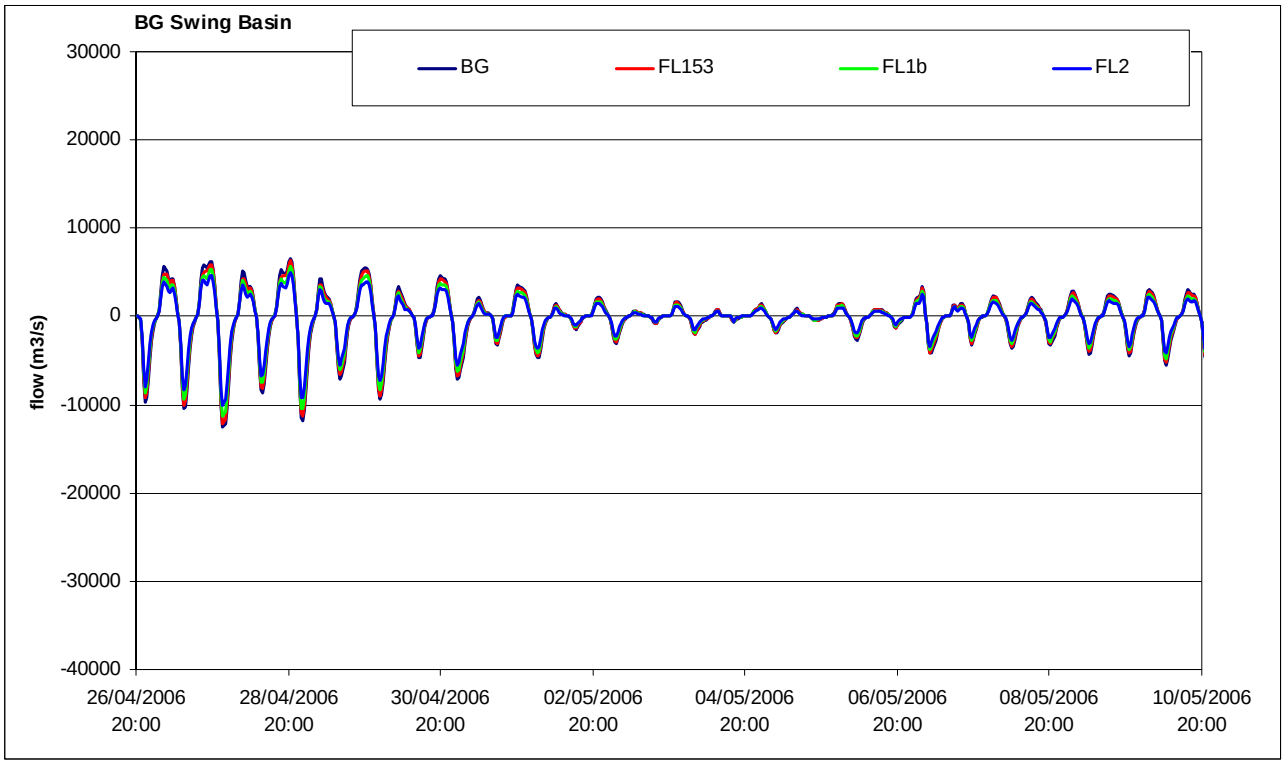

Figure 18 Flow Timeseries Through QGC Swing Basin Profile

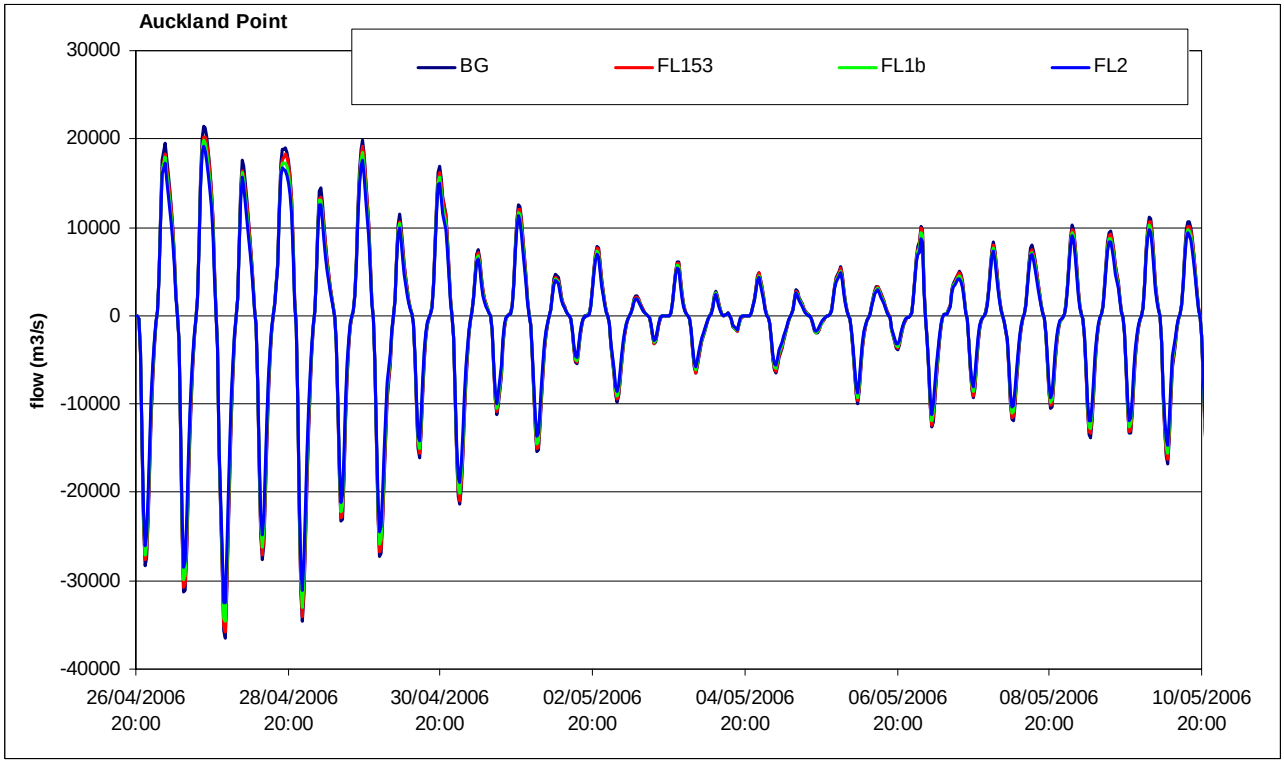

Figure 19 Flow Timeseries Through Auckland Point Profile

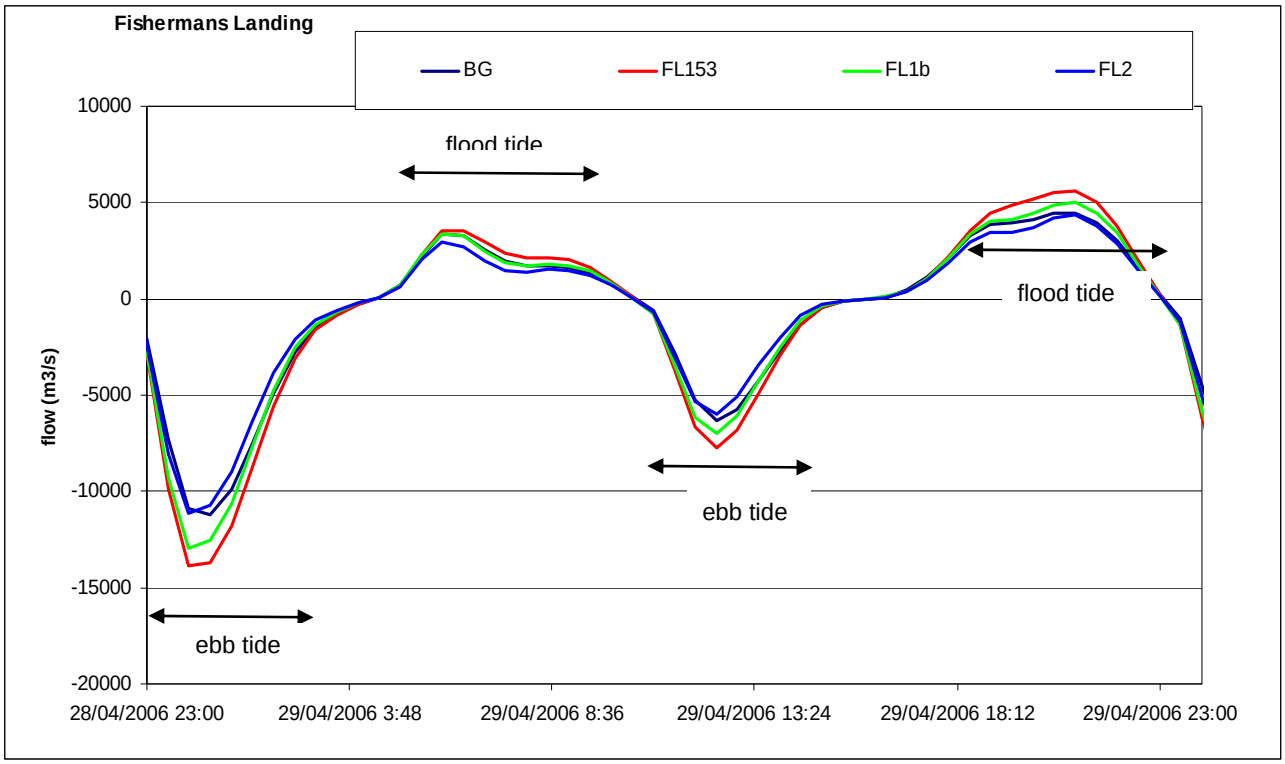

Figure 20 Flow Timeseries Through Fishermans Landing Profile - Zoom

3. Limitations

The assessment reported in this document is relative only to the reference case defined above. Results should be interpreted accordingly with the limitations associated with the modelling. These include:

- The model bathymetry and calibration status in and around the Fishermans Landing area and associated tidal flats is uncertain, and as such the results from the model in this area should be treated with caution and should not be relied on for detailed assessments. This applies to the reference case, as well as the various reclamation options. The subsequent tranche of works will have much more reliable bathymetric and tidal flow calibration data available to it and model upgrades will be undertaken accordingly. It is also understood that QGC is collecting related data in this areas and may be able to provide this to the subsequent modelling effort;
- The proposed features included in the reference case (dredging, reclamation and bridge) are based on layouts provided in late 2008;
- The dredging at Wiggins Island and the Targinie channel widening have not been included in this assessment. This is likely to have a minor or no effect on predicted results, as this is a relative assessment;
- The model mesh along the reclamation option layouts is relatively coarse at the moment. This is sufficient for a broad level impact assessment as conducted here. However, subsequent modelling and assessment of the detailed characteristics of a preferred reclamation option should see mesh refinement in this area, in order to provide more robust hydrodynamic impact results.

Please do not hesitate to contact me if you have any queries on the above or would like to discuss any matter further.

Yours Faithfully
BMT WBM Pty Ltd

Michael Barry, Fanny Houdré