Discussion notes for Port meeting ~ 28 June 2018 ~ 2pm



This is a follow-on from our Pre-hearing meeting last Wednesday...

You said that you are doing some more modelling that shows that the really fine material contained in the sand dumped at Westshore last October, is travelling east towards Pania Reef

Are you taking ADCP current measurements as well? (If yes) Where are the ADCP's located?

(If yes) Will you be presenting more scientific information prior to the hearing?

As you know, I have some things I would like clarified with the scientific data Advisian has presented.

(1) a Firstly: the calibration of the numerical model. Could you put on the screen p.19 from Appendix. E "Dredge Plume modelling"

The top graph shows the "Best fit" velocity magnitude. And the wind and current Rose, shows the 9 days of data.

Look at the orange lines representing the wind. There is hardly any wind coming from the NE, E, SE, S, and SSW. It was essentially a period of gradient wind from the west. If you imagine the orange lines not being there, you will see the green and blue lines, which represent the modelled and measured data, don't actually superimpose very well.

b To back up what I am saying, let's look at Fig. 14 on the previous page (18).

We are looking at cross plots of current velocity only (not current direction). The scales are velocity in mm/s, with a maximum value being 200 for both X & Y axes ... except for Runs 8 & 9, where the maximum is 300, so just imagine for the time being they are plotted to the same scale.

c This is my interpretation of what I can see here, and if you think I am wrong, please put me right.

These plots represent the same data set of measured values, cross-plotted against the predicted values from the numerical model. But the predicted model values are slightly different for each run. In this case, the "wind drag coefficient" is varied and it looks like each run has a slightly larger wind drag coefficient, as the modelled velocity increases with wind drag, which makes sense.

Let's look at Run #7 (the best fit). Now go up the vertical axis until you reach 40. You can see a modelled data point at 10, and then heading off to the right you can see data points all the way out to 110.

Similarly, go up the vertical axis to 140. You can see a modelled data point at 30 .... then heading off to the right there are data points all the way out to 190.

These are huge variations, which is why the cross-plot looks like a sign blasted with shot-gun pellets, rather than a typical calibration cross-plot.

It's worth noting that the first run (#4) contains a different data set, so it doesn't apply. You can tell it is an odd set, because there is only one measured data point between 180 & 200 .... whereas there are 4x measured data points for all the other plots in this band.

d After the calibration period of 9 days was completed, Advisian did a model validation in July 2016. The validation plot for the Beacons ADCP is shown in Fig. 17 on p. 22 of Appendix E.

This plot is very hard to assess, because the time scale is too compressed and 3 lines are plotted on the same graph.

e Please could you ask Advisian to provide this data in a much clearer format, by:
a) plotting the time scale similar to Fig. 16, p. 21, with no more than 8 days across the page.
b) plotting separately: the 2 current velocities, the 2 current directions and the windspeed and wind direction, on separate plots.

This will then allow us to assess the validity of the calibrated model, when applied to the Beacons location.

(2) Secondly, I would like some clarification with respect to the wind data used, and it's application to the numerical simulations.

a Could you put on the screen p. 25 from Appendix. F "Post-disposal Fate of Dredged Sediments"
Looking at the last paragraph ..... it reads as follows....
"Table 3-1 shows the number of days per year the 24 hr storm wind speed is exceeded for a total of 12 hours or more. Although it is rare that such wind speeds would blow continuously for 24 hours, the spin-up time of the water column typically is less than this. Sensitivity analysis with the calibrated FLOW model suggests that for the wind speeds considered, the water column around Napier Port will achieve equilibrium current speed in approx 12 hours.

Therefore Table 3-1 gives an indication of how often the simulated conditions might be expected to occur.

b This last sentence is very important, because Table 3-1 contains some pretty high numbers.... especially with winds from the westerly quadrant. We can see 10, 11, 12, 15, 16 even 18. 18 days per year the threshold windspeed is exceeded!
According to this table, the wind blows from the west at 15·8 m/s, or more, for 12 hours continously for up to 16 times per year. If you are not familiar with wind speed units 15·8 m/s is 57 km/hr which is Force 7 on the Beaufort Scale.

c I have obtained from NIWA's database the hourly-averaged wind data for Napier Airport, which Advisian confirms is similar to the Ports wind data (App. D, p.7)

I have analysed the data from 2004 to 2012 and I arrive at a different result. In 2004 there were 2 periods when the wind blew for 12 hours or more above the threshold windspeed, and in 2008 there was 1 period.

In all the other years there were none. So for the whole year in 2005, 6, 7, 9, 10, 11 & 12 there were no occurances. So the sentence at the top of the page, that says Table 3-1 gives an indication of how often the simulated conditions might be expected to occur, is not true. Table 3-1 should be full of zeros, except for a 2 in 2004 for SW, and 1 in 2008 for NE.

d I then asked myself, how could this table be so wrong? Surely a big consulting firm like Advisian wouldn't make mistakes like this? But when I looked closer at the page, I could see the client's name was Napier Port Ltd, not Port of Napier Ltd, and I thought, well yes, simple mistakes are easy to make.

So why is Table 3-1 so wrong? It is because the person doing the analysis of the wind data, used the wrong units of wind speed. They used the hourly-averaged wind speed numbers that you can see in the table, as knots instead of m/s; probably because the raw data from the Port's anemometer is recorded in knots, as per standard marine practice. All over the world, the marine industry uses knots as the standard unit of wind speed.

The difference between m/s and knots is approx a factor of 2.
i.e: 10 m/s ≈ 20 knots
So I did an analysis of the 2004 Airport wind data using knots instead of m/s, for the threshold wind speed.

e The analysis yeilded the following:

| 2004 | N | NE | E | SE | S | SW | W | NW | Total |
|---|---|---|---|---|---|---|---|---|---|
| Advisian (m/s) | - | 6 | - | - | - | 5 | 11 | 4 | 26 |
| Airport (knots) | - | 5 | - | - | - | 10 | 10 | 1 | 26 |

The differences between the westerly quadrant winds make sense. The airport met mast is very exposed to the SW, whereas the Port met mast, in 2004, was probably on the admin building back then, and would have been much less exposed to the SW wind.

The Port also has a huge fetch of open water to the NW, whereas NW winds at the airport are very gusty, because the foothills are so close.

f So, without a doubt, Table 3-1 is incorrect, and the reason for this significant error has been identified. This error doesn't change the modelling process, if your goal is to show that the disposal ground 5 km off Marine Parade will not affect Pania Reef, even in the most extreme wind conditions. In fact, on p.12 of the S.92 response, is written ... "The simulations shown .... were run, assuming extremely severe conditions that were not observed in wind data between 2005 and 2015."

g And this is where I have an issue. You are now starting to tell us about how Advisian's modelling shows that dumping sand at Westshore will have an adverse effect on Pania Reef.

And you are using the Total Transport patterns on page 53 of Appendix F, as the foundation for your evidence, combined with the first sentence on p.14 of the S.92 response ... which reads .... "The circulation patterns for a lower wind speed will be the same, but with a lower current."

h I believe this statement is incorrect: As the wind speed gets lower, it's influence on the currents around Westshore dimishes. You can see this with the calibration cross-plots I talked about earlier (Fig. 14, p.18, App. E). For each incremental increase in the wind drag coefficient (which is a parameter related to the frictional resistance of the sea surface, relative to the atmosphere) you can see the mid-values of the modelled velocity increasing by about 20 mm/s. This is significant, considering the current velocity in light winds is around this order of magnitude.

i In these lighter winds, which occur for over 50% of the year, the effects of the tide and the substantial flow of water in and out of the Ahuriri Estuary is likely to have more influence than the wind.

The current measurements done by ASR, many years ago in Westshore Bay, show the regular changes in direction of the current in lighter wind conditions. One of the authors of the ASR report (2001) confirmed for me that these oscillations in the current direction were due to the regular tidal fluctuations.

j So based on what I have presented to you; would you agree that it would be incorrect to make assessments of the predicted behaviour of the sea currents, off Westshore Beach, using the Advisian numerical modelling presented in Appendices D, E and F ?

k Do you agree with my analysis of the data in Table 3-1 ? If yes, do you agree to providing an Erratum to this table, prior to the hearing ?

(3) Thirdly, I would like to discuss a comment made by Martin Single of Shore Processes and Management in the S.92 response on page 12. At the end of the first paragraph he talks about the placement of suitable dredged material in Area R extended, to provide nourishment for the beach. His final sentence says... "If HBRC monitoring shows this to not be beneficial, then that activity could be stopped."

The HBRC monitoring is showing that the October 2017 disposal of sand, close to the surf club, is having a beneficial effect on the near shore sand level in that vicinity. In addition, the accretion of the beach at the Northumberland wreck site (HB15) and Fannin St, BayView (HB16) could be attributed, in part, to the disposal of dredge material in R extended over the years.

It is also worth noting that the big swells earlier this month, that you have reported in the paper as being 8.5m, did quite a bit of overtopping & back-gouging of the shingle bank between Nott St & Naomi St, but did very little damage to the shingle bank in front of the surf club. The energy in the swells running up the foreshore was reduced, without the usual scouring that occurs in front of the surf club. This was very encouraging to observe and shows the sand deposited in October last year is having a beneficial effect.

Thankyou for the opportunity to table my issues with aspects of the Technical Reports

Richard Karn
28 June 2018

Appendix E : Dredge Plume Modelling report (Advisian).   p19

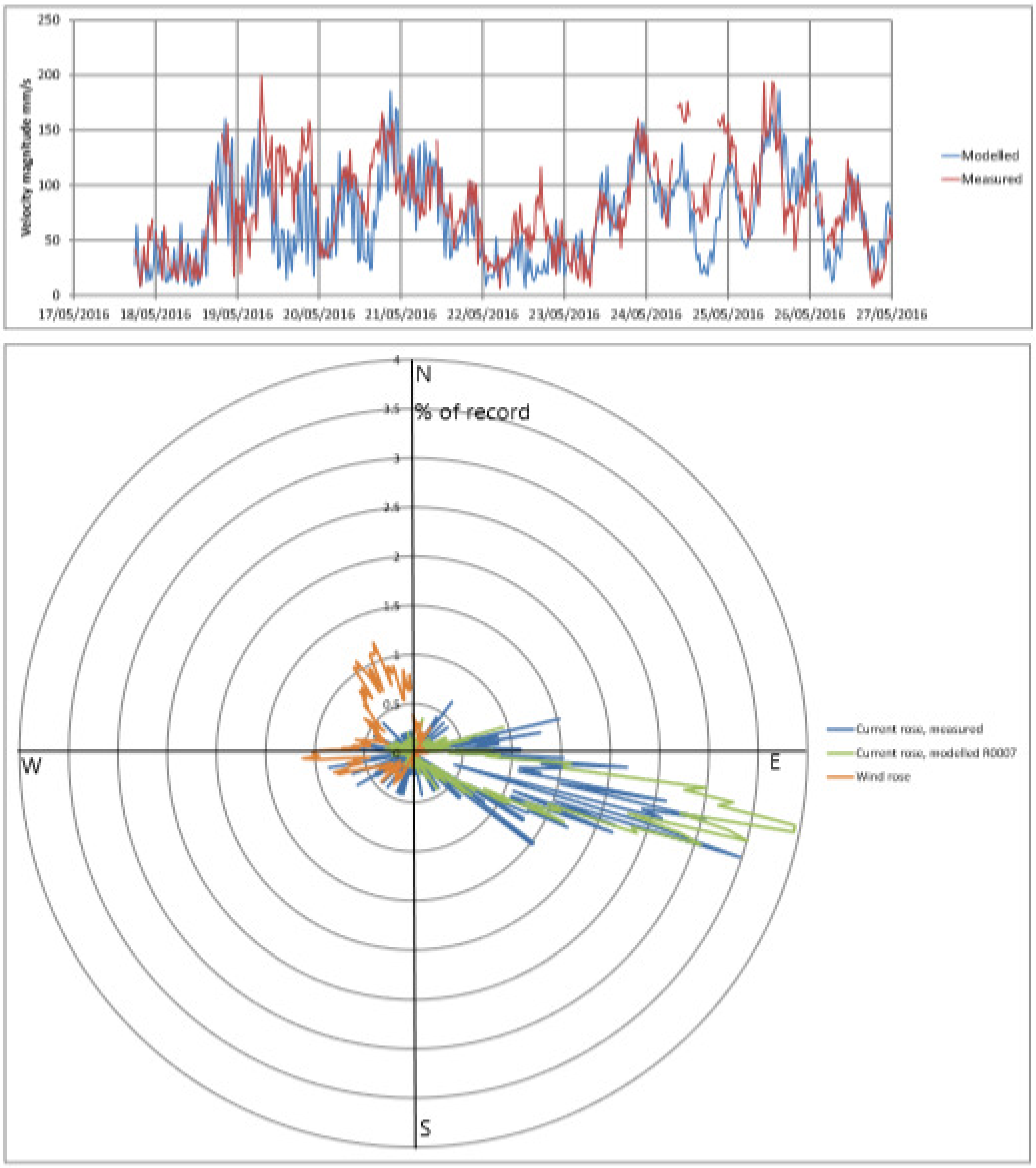



**Figure 15 – Modelled vs. measured current directions and magnitude time series for calibration period (note – wind direction shown is direction from which the wind is coming; current direction is the direction to which the current is travelling)**

Appendix E : Dredge Plume Modelling report (Advisian).   p18

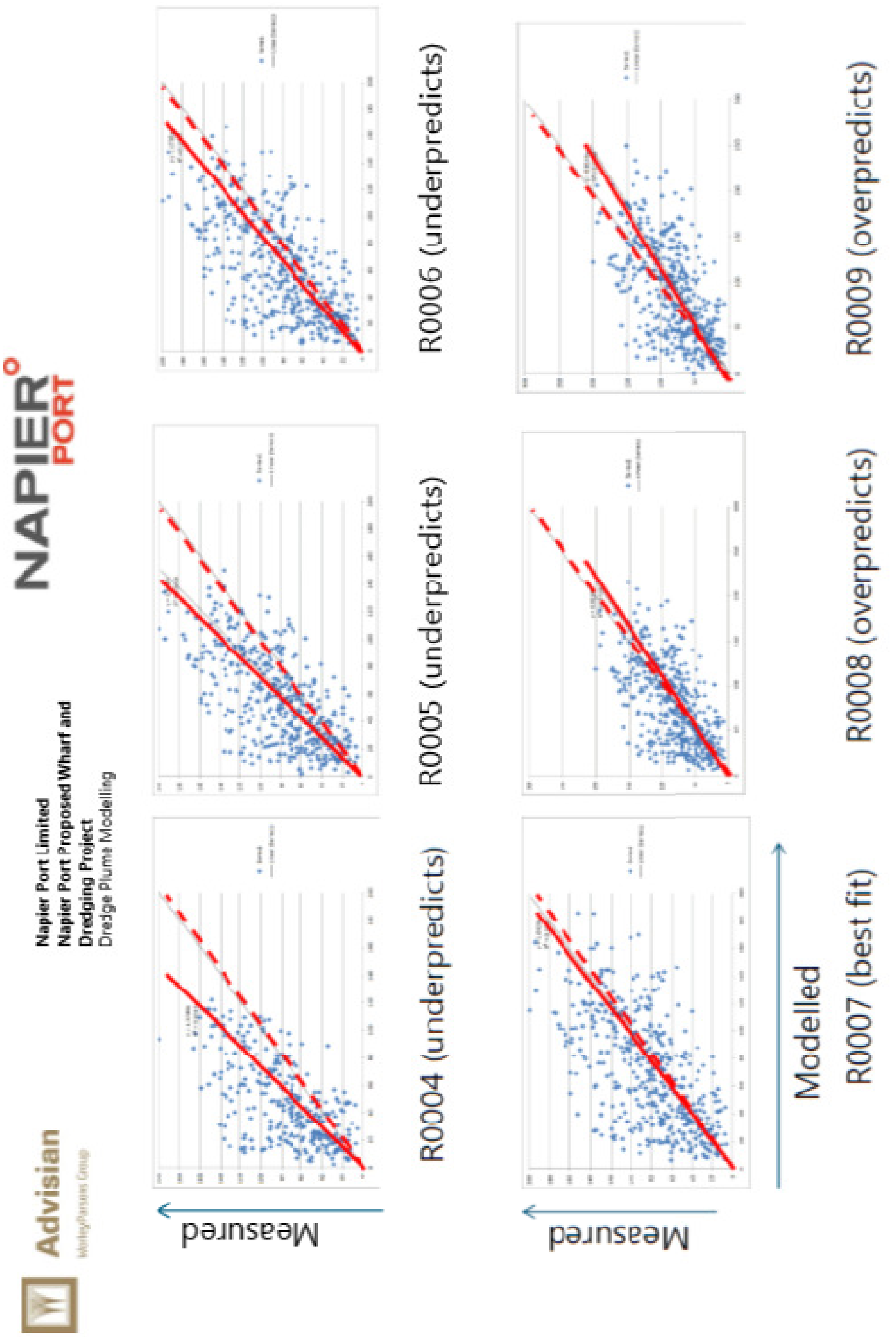
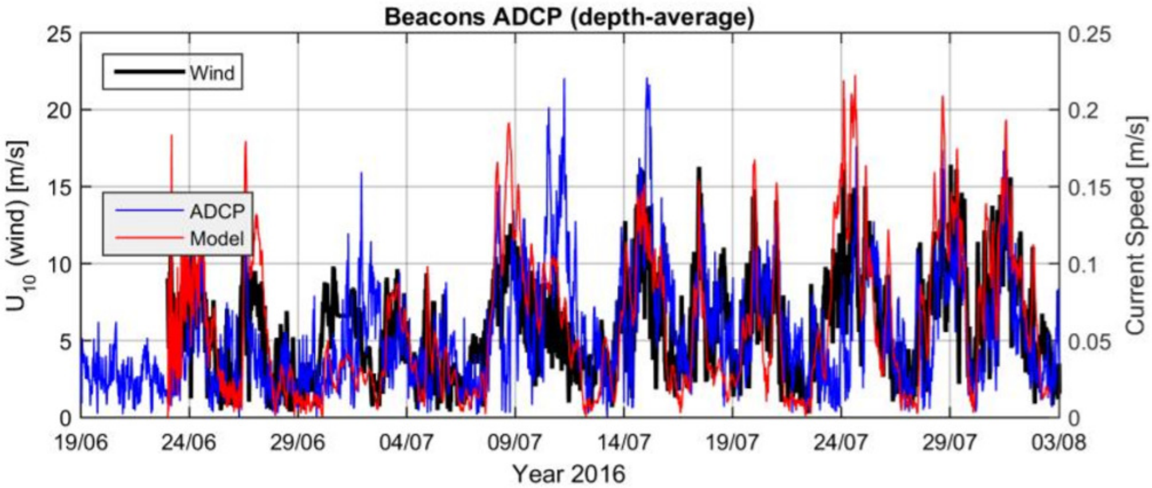



Figure 14 – Variation in modelled vs. measured velocities over the calibration period, for varying wind drag coefficients

Appendix E : Dredge Plume Modelling report (Advisian). p22. Fig.17 middle graph




Appendix F: Post-Disposal Fate of Dredged Sediments (Advisian). P25. Section 3.2.3 Wind Forcing

### 3.2.3 Wind Forcing

Ten years of wind data at Napier Port was analysed to determine storm wind speeds and variation with incident direction. For the purpose of this analysis, the hourly-averaged wind speed not exceeded for more than 24 hours per year was selected to drive the 3D hydrodynamic model. The application of this wind speed is justified on the basis that:

(a) It provides sufficient energy to 'spin up' the water column in a practical amount of time for numerical computation.

(b) Once suspended, sediments are transported in the direction of currents in the overlying water column. As the carrying-capacity of a current typically is proportional to the cube of its speed ($u^3$), patterns of net and gross transport are typically dictated by current patterns under energetic conditions rather than quiescent conditions.

Table 3-1 shows the number of days per year the 24-hour storm wind speed is exceed for a total of 12 hours or more. Although it is rare that such wind speeds would blow continuously for 24 hours, the 'spin-up' time of the water column typically is less than this. Sensitivity analysis with the calibrated FLOW model suggests that, for the wind speeds considered, the water column around

Appendix F: Post-Disposal Fate of Dredged Sediments (Advisian). P26.

Napier Port will achieve equilibrium current speed in approximately 12 hours. Therefore Table 3-1 gives an indication of how often the simulated conditions might be expected to occur.

The storm wind speeds applied in Delft3D are shown in Table 3-2. Note that the highest wind speeds occur from the west, north-west, east and south-east. This compares with relatively low storm wind speeds occurring from the south-west, even though this is the most frequently occurring direction (Figure 2-2).

**Table 3-1: Analysis of 1-minute wind speeds, averaged to hourly intervals.**

| Sector | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| Hourly-averaged Speed (m/s) | 12.5 | 10.4 | 12.3 | 12.6 | 11.1 | 11.4 | 15.8 | 15.2 |
| Year | Number of days per year wind speed is exceeded for 12 hours or more | | | | | | | |
| 2004 | 0 | 6 | 0 | 0 | 0 | 5 | 11 | 4 |
| 2005 | 0 | 3 | 2 | 3 | 0 | 2 | 3 | 2 |
| 2006 | 0 | 2 | 1 | 1 | 0 | 5 | 11 | 7 |
| 2007 | 0 | 2 | 2 | 2 | 0 | 0 | 16 | 5 |
| 2008 | 0 | 6 | 2 | 1 | 0 | 1 | 5 | 6 |
| 2009 | 0 | 4 | 0 | 1 | 0 | 1 | 7 | 1 |
| 2010 | 0 | 5 | 0 | 1 | 1 | 3 | 3 | 3 |
| 2011 | 2 | 10 | 0 | 1 | 1 | 15 | 2 | 0 |
| 2012 | 4 | 2 | 4 | 4 | 0 | 11 | 12 | 3 |
| 2013 | 4 | 3 | 2 | 1 | 0 | 7 | 3 | 4 |
| 2014 | 2 | 5 | 6 | 1 | 0 | 18 | 10 | 5 |

**Table 3-2 – Storm wind speeds at Napier applied in the 3D hydrodynamic model**

| Wind direction | Wind speed (m/s) |
|---|---|
| North-East | 10.4 |
| East | 12.3 |
| South-East | 12.6 |
| South-West | 11.4 |
| West | 15.8 |
| North-West | 15.2 |