Appendix 17
Flood Modelling

DHI Water and Environment Pty Ltd

May 2007

Warner Industrial Park Concept Plan and Project Application

Precinct 14 WEZ

Sparks Rd and Hue Hue Rd
Warnervale
June 2008

80
TERRACE
TOWER
GROUP

Warner Business Park Pty Ltd
Part of the Terrace Tower Group

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architecture planning urban design

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Our Ref: 50470/002/gps

Date: 02 May 2007

TREHY INGOLD NEATE
PO Box 3205
Tuggerah NSW 2259

Attention: Mr Peter Ingold

Dear Peter,

Re: Wyong Employment Zone Additional Flood Modelling – Precinct 14

Introduction

DHI Water and Environment Pty Ltd (DHI) was engaged by Trehy Ingold Neate (TIN) to undertake additional hydraulic modelling of Precinct 14 of the proposed Wyong Employment Zone (WEZ) development in the Buttonderry Creek catchment.

The objective of this present study was to investigate different development and filling scenarios within Precinct 14 with the aim of minimizing the impact of development on flood levels. Precinct 14 is about 130 hectares in size and is located in the upper reaches of the Buttonderry Creek catchment immediately north of the Sydney-Newcastle F3 Freeway. The floodplain area on Precinct 14 is presently flooded by broad, shallow overland flood flows. The proposed development will significantly affect the existing flow behaviour; as the floodplain is to be filled and the overland flood flows are to be confined to engineered channels and pipe as described below.

- The current development proposal is to place up to 2m of fill on the floodplain in a configuration based on plan ref: 19426/MA01 Revision E;
- Development options also include the piping of low flows from catchment B2 to replace the existing ill-defined channel from downstream of Hue Hue Road to the confluence with B1. The overland flow is to be conveyed along the proposed roads before entering B1.
- A clear span bridge is proposed to be built over flow path B1 at chainage 372m.
- Compensatory flood storage is to be added on both sides of the creek channel B1, downstream of the catchment F2 and along the by-pass channel F1-F2.
- The existing shallow/undefined flow path on catchment F2 is to be relocated into a channel parallel to the road along the eastern side of the property. The new channel bed level is to be higher than the existing natural flow path level. There is some scope to adjust the width of this channel with the aim of minimising flood levels in the vicinity.

Figure 1 shows the location of branches and cross-sections in Precinct 14.

Three main flooding issues within Precinct 14 were assessed by DHI Water and Environment as part of the development options. Results of the investigation for 1% AEP flood event are presented in this report.

Investigation of Development Options

The key objectives for this investigation were to:

1. Assess the capacity of channels and storage areas with the aim of minimising 1% AEP flood levels on catchment F2 in suitable balance with the requirement to maximise the developable fill footprint.

2. Optimise the width of the clear span bridge to be built above flow path F1 (Buttonderry Ck) for flood level impact in the vicinity of the structure

3. Examine designs for the piped stormwater / overland flow paths to replace the existing B2 flow path.

The investigation was undertaken using the existing Mike 11 hydraulic model for the area. The basis for comparison of the current modelling was the development scenario Option 3A and the Existing Case as described in DHI's 2006 report (Wyong Employment Zone – Additional Flooding Assessment – Final Report For Wyong Shire Council).

1. Reduction of Flood Levels on F2

Water levels on catchment F2 are predicted to increase significantly in the proposed development option compared to the existing levels as a consequence of the new channel to be implemented and of flood volume redistribution immediately upstream of the F3 Freeway from B1 catchment to F2 catchment.

Flood results on F2 for Option 3A were found to be higher than the existing case but constrained within the proposed engineered channel. The channel roughness used for F2 in for this case was a Manning's n coefficient of 0.030.

In previous discussions with Wyong Shire Council, Council recommended a channel roughness coefficient for the designed channel of 0.080 for the F2 tributary. The maximum flood levels for model analysis of this case are presented in Table 1.

Results in Table 1 indicate that a channel roughness of 0.080 will result in flood levels overtopping the proposed fill adjacent to F2 by up to 0.5m. The proposed engineered channel does not have enough capacity to convey the 1% AEP flood event.

Table 1: Roughness impact on flood levels.

Model Location	Top of Bank/Filling Level (mAHD)	Existing case (mAHD)	Option 3A, n=0.03 (mAHD)	Base Case: Option 3A and n=0.08 (mAHD)	Base Case – Top of Bank on F2 (m)
B1 -373.00	23.28	24.16	24.16	24.16	
B1 0.00	22.82	22.33	22.34	22.34	
B1 350.00	20.58	20.46	20.33	20.33	
B1 630.00	20.00	19.76	19.62	19.63	
B1 760.00	19.28	19.73	19.62	19.62	
F1 280.00	20.08	19.18	19.36	19.44	
F1 550.00	18.08	19.18	19.36	19.44	
B2 -72.00	28.33	28.39	28.39	28.39	
B2 13.50	27.83	26.67	25.29	25.27	
B2 490.00	19.69	19.73	19.62	19.63	
F2 0.00	25.64	25.23	25.24	25.23	-0.41
F2 90.00	26.12	24.71	24.77	24.87	-1.25
F2 140.00	24.24	23.80	24.17	24.68	0.44
F2 210.00	23.97	23.21	23.90	24.34	0.37
F2 280.00	23.43	22.63	23.37	23.80	0.37
F2 350.00	22.88	21.91	22.80	23.26	0.38
F2 420.00	22.52	21.16	22.23	22.72	0.20
F2 490.00	21.75	20.64	21.66	22.10	0.35
F2 560.00	21.13	20.19	21.02	21.49	0.36
F2 630.00	20.53	19.81	20.44	20.92	0.39
F2 700.00	19.99	19.39	19.87	20.42	0.43
F2 770.00	19.57	19.08	19.36	20.08	0.51
F2 840.00	19.31	19.08	19.34	19.78	0.47
F2 910.00	19.21	19.07	19.34	19.43	0.22
F2 980.00	19.20	19.07	19.34	19.42	0.22
F2 1050.00	19.48	19.07	19.34	19.42	-0.06
B1-F1 0.00	20.02	19.73	19.62	19.62	
B1-F1 35.00	22.00	19.69	19.62	19.62	
B1-F1 75.00	20.02	19.18	19.41	19.44	
F1-F2 0.00	18.30	19.07	19.40	19.42	
F1-F2 180.00	19.48		19.41	19.43	
F1-F2 210.00	19.48	19.18	19.41	19.43	
F1-F2 350.00	19.48	19.18	19.41	19.44	

Additional runs were undertaken to investigate options to reduce flood levels on F2. Three different roughness coefficients were trialled:

- 0.080 as per Council's requirement;
- 0.060, which is coefficient used for the other branches of the model; and
- 0.030 which would reflect a maintained channel.

Model results for these scenarios are presented in Table 2. A summary of the scenarios tested is provided below.

- Model cross-sections on F2 were first altered and made 5 m wider in TEST 1. In accordance with our discussion with TIN, cross-sections cannot be made more than 5 m wider due to the physical constraints of the channel corridor. Flood levels for this

channel size, as shown in Table 2, are still above the filling level for both roughness coefficients 0.08 and 0.06.

- For the second test run (TEST 2), the 5m wider cross-sections on F2 were used and the link channel F1-F2 between catchments F2 and F1 was altered to limit the flood volume coming from catchment B1 in order to replicate the current flow exchange on the existing floodplain. With this refined flow balance the developed flood levels are within 0.1m of the existing flood levels adjacent to the freeway embankment. However, flood flows will still be overtopping the proposed fill in the upstream part of the F2 Channel by up to 0.3 m. Flood levels are anticipated to be increased slightly on catchment B1 and F1 just upstream of the F3 Freeway, but will remain within 0.15m of the existing levels.
- In the final model test (TEST 3), the 5m wider cross-sections F2 and the reduced link between F2 and F1 were used. Cross-sections on F2 were also altered to include higher bank levels to constrain the flow within the defined channel corridor. Results presented showing the maximum flood levels for Manning's n roughness values of 0.080, 0.060 and 0.030.

Table 2: Comparison of flood levels for different options on F2

Model Location	Top of Bank/Filling Level (mAHD)	TEST 1 n=0.08 (mAHD)	TEST 1 n=0.06 (mAHD)	TEST 2 n=0.08 (mAHD)	TEST 2 n=0.06 (mAHD)	TEST 3 n=0.08 (mAHD)	TEST 3 n=0.06 (mAHD)	TEST 3 n=0.03 (mAHD)
B1 -373.00	23.28	24.16	24.16	24.16	24.16	24.16	24.16	24.16
B1 0.00	22.82	22.34	22.34	22.34	22.34	22.34	22.34	22.34
B1 350.00	20.58	20.33	20.33	20.33	20.33	20.33	20.33	20.33
B1 630.00	20	19.63	19.63	19.66	19.66	19.66	19.66	19.66
B1 760.00	19.28	19.62	19.62	19.66	19.66	19.66	19.66	19.66
F1 280.00	20.08	19.42	19.41	19.58	19.58	19.58	19.58	19.57
F1 550.00	18.08	19.42	19.41	19.58	19.58	19.58	19.58	19.57
B2 -72.00	28.33	28.39	28.39	28.39	28.39	28.39	28.39	28.39
B2 13.50	27.83	25.27	25.27	25.27	25.27	25.27	25.27	25.27
B2 490.00	19.69	19.62	19.62	19.66	19.66	19.66	19.66	19.66
F2 0.00	**25.64**	**25.24**	**25.24**	**25.24**	**25.24**	**25.24**	**25.24**	**25.07**
F2 90.00	**26.12**	**24.81**	**24.78**	**24.81**	**24.78**	**24.83**	**24.79**	**24.66**
F2 140.00	**24.24**	**24.51**	**24.36**	**24.51**	**24.36**	**24.58**	**24.42**	**24.03**
F2 210.00	**23.97**	**24.18**	**24.04**	**24.18**	**24.04**	**24.26**	**24.09**	**23.77**
F2 280.00	**23.43**	**23.65**	**23.51**	**23.65**	**23.51**	**23.71**	**23.56**	**23.24**
F2 350.00	**22.88**	**23.10**	**22.95**	**23.10**	**22.95**	**23.15**	**23.00**	**22.67**
F2 420.00	**22.52**	**22.54**	**22.40**	**22.54**	**22.40**	**22.61**	**22.45**	**22.10**
F2 490.00	**21.75**	**21.95**	**21.81**	**21.95**	**21.81**	**22.02**	**21.86**	**21.54**
F2 560.00	**21.13**	**21.34**	**21.19**	**21.34**	**21.19**	**21.41**	**21.24**	**20.91**
F2 630.00	**20.53**	**20.74**	**20.59**	**20.74**	**20.59**	**20.83**	**20.65**	**20.31**
F2 700.00	**19.99**	**20.23**	**20.06**	**20.23**	**20.06**	**20.31**	**20.12**	**19.76**
F2 770.00	**19.57**	**19.88**	**19.71**	**19.88**	**19.71**	**19.97**	**19.78**	**19.37**
F2 840.00	**19.31**	**19.60**	**19.44**	**19.60**	**19.44**	**19.66**	**19.48**	**19.11**
F2 910.00	**19.21**	**19.40**	**19.39**	**19.16**	**19.14**	**19.16**	**19.14**	**19.10**
F2 980.00	**19.2**	**19.40**	**19.39**	**19.15**	**19.13**	**19.15**	**19.13**	**19.10**
F2 1050.00	**19.48**	**19.40**	**19.39**	**19.15**	**19.13**	**19.15**	**19.13**	**19.10**
B1-F1 0.00	20.02	19.62	19.62	19.66	19.66	19.66	19.66	19.66
B1-F1 35.00	22.00	19.62	19.62	19.65	19.65	19.65	19.65	19.65
B1-F1 75.00	20.02	19.42	19.41	19.58	19.58	19.58	19.58	19.57
F1-F2 0.00	18.3	19.40	19.39	19.15	19.13	19.15	19.13	19.10

Model Location	Top of Bank/Filling Level (mAHD)	TEST 1 n=0.08 (mAHD)	TEST 1 n=0.06 (mAHD)	TEST 2 n=0.08 (mAHD)	TEST 2 n=0.06 (mAHD)	TEST 3 n=0.08 (mAHD)	TEST 3 n=0.06 (mAHD)	TEST 3 n=0.03 (mAHD)
F1-F2 180.00	19.48	19.41	19.40	19.16	19.14	19.16	19.14	19.11
F1-F2 210.00	19.48	19.41	19.40	19.16	19.14	19.16	19.14	19.11
F1-F2 350.00	19.48	19.42	19.41	19.17	19.15	19.17	19.15	19.12

We understand that it is the developer's intention to enter into a Management Deed between the developer and the lot owners to manage the vegetation within the drainage corridor to maintain the nominated 'n' value of 0.030.

2. *Optimisation of the Bridge Size on B1*

A clear span bridge over branch B1 is proposed for a location at creek chainage 372 m. A 30m clear span bridge was included in Option 3A. Model results (DHI's 2006 report) showed that the bridge was not expected to adversely impact on the 1% AEP flood behaviour and flood levels are expected to be lower than the existing levels.

Additional model runs were undertaken to determine whether the span could be further reduced. A 20m clear span bridge on B1 was trialled. The width of the bridge was reduced but a similar cross-section for the flow area under the bridge was used as shown on Figure 2.

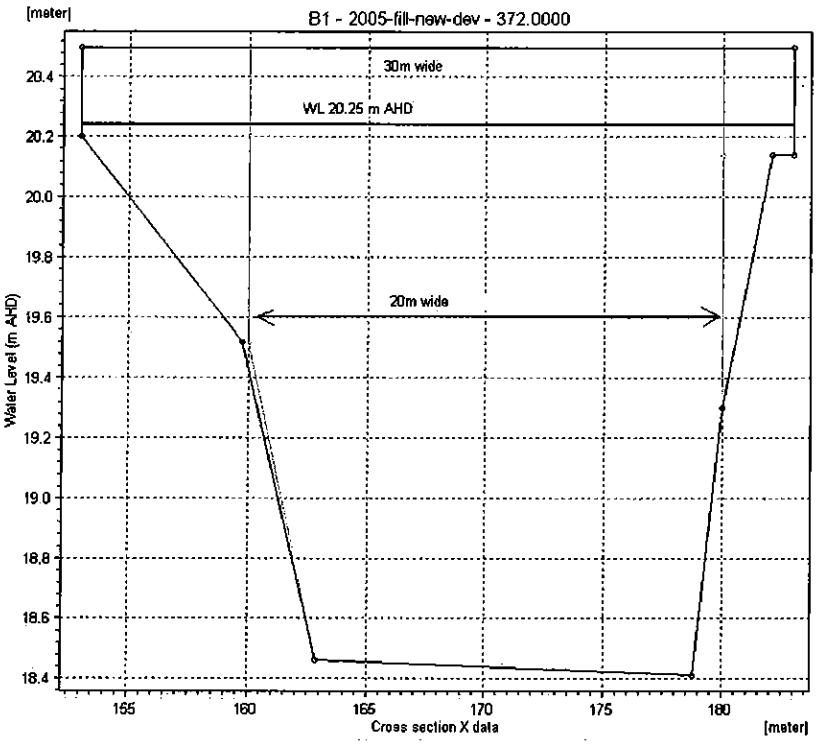


Figure 2: Typical cross-section for the bridge on B1.

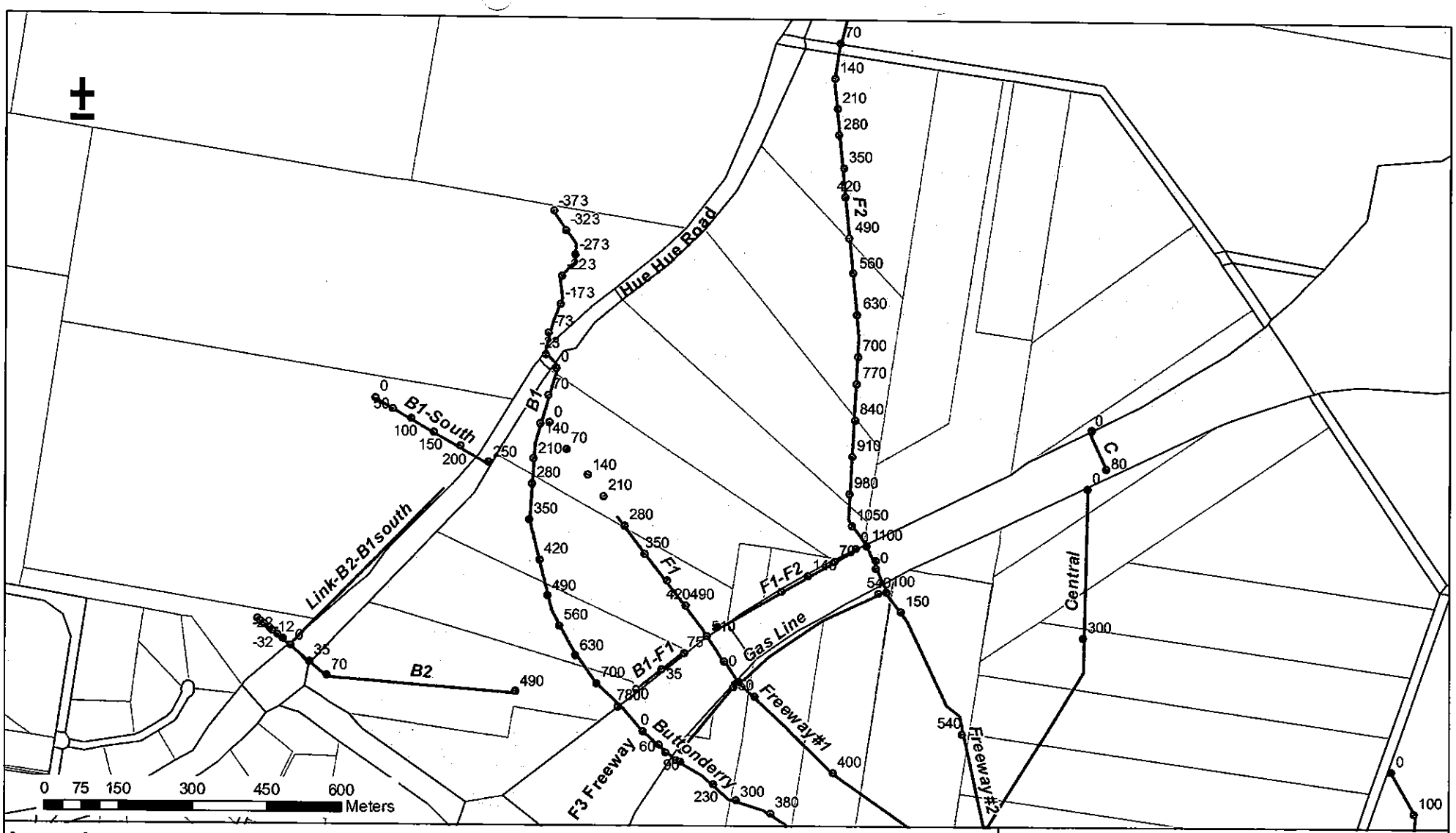
Results presented in Table 3 show that the flood levels are similar to the Option 3A case at the bridge site but may increase by up to 0.15 m upstream of the bridge and by 0.05 m immediately downstream. Flood levels are however expected to be lower than the levels predicted for existing floodplain conditions.

Table 3: Flood levels comparison on B1.

	Top of Bank Level	Existing Max Level	Option 3A, 30m Bridge, Max Level	Test 1 20m Bridge, Max Level	Difference 20m-30m	Difference 20m-Existing
Mike 11 Chainage	m AHD	mAHD	mAHD	mAHD	m	m
B1 -373.00	23.28	24.16	24.16	24.16	0.00	0.00
B1 -323.00	23.54	23.99	23.99	23.99	0.00	0.00
B1 -273.00	23.46	23.70	23.70	23.70	0.00	0.00
B1 -223.00	23.17	23.37	23.37	23.37	0.00	0.00
B1 -173.00	22.88	23.20	23.20	23.20	0.00	0.00
B1 -123.00	22.29	23.10	23.11	23.11	0.00	0.00
B1 -73.00	22.04	23.07	23.07	23.07	0.00	0.00
B1 -53.00	22.20	23.06	23.06	23.06	0.00	0.00
B1 -43.00	21.89	23.06	23.06	23.06	0.00	0.00
B1 -28.00	22.13	22.54	22.54	22.54	0.00	0.00
B1 0.00	22.82	22.33	22.34	22.33	0.00	0.01
B1 70.00	21.89	21.48	21.46	21.47	**0.01**	**-0.01**
B1 140.00	21.21	21.01	20.88	20.94	**0.06**	**-0.07**
B1 210.00	21.12	20.94	20.76	20.86	**0.10**	**-0.08**
B1 280.00	20.91	20.74	20.52	20.67	**0.15**	**-0.07**
B1 350.00	20.58	20.46	20.33	20.39	**0.06**	**-0.07**
B1 372.00	**20.58**	-	**20.24**	**20.25**	**0.01**	
B1 420.00	20.27	20.27	20.16	20.21	0.05	-0.06
B1 490.00	20.05	20.06	20.00	20.01	0.01	-0.05
B1 560.00	20.02	19.79	19.69	19.73	0.04	-0.06
B1 630.00	20.00	19.76	19.62	19.67	0.04	-0.09
B1 700.00	20.02	19.73	19.62	19.63	0.01	-0.10
B1 760.00	19.28	19.73	19.62	19.63	0.01	-0.10
B1 800.00	18.05	17.97	17.95	17.95	0.00	-0.02

Yours faithfully
DHI Water and Environment Pty Ltd

Grantley Smith
State Manager
Personal Email: gps@dhigroup.com



Legend

- Approximate Location of Cross-sections (Chainage in m)
- Mike 11 Network
- Roads
- Cadastre
- Precinct 14
- Full WEZ Boundary

DHI WATER & ENVIRONMENT

Figure 1

Model Cross-Sections
Precinct 14