

# CENTRAL INTERCEPTOR

## Memorandum

To: Duncan Kingsbury, Nigel Kay

From: Jeremy Tan

Reviewed: Andrew Campbell

CC:

Subject: Settlement implications due to revision of the Main Tunnel and Link Sewer C

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### 1. Introduction

This memorandum gives our summary for the anticipated settlement due to horizontal variance from the consented alignment of the main tunnel near Western Springs and May Rd; and the revised vertical and horizontal alignment of Link Sewer C along its length. The Areas where the tunnel alignments move outside the consented boundaries are shown on Drg 2012064.025.

This memo will refer back to the main documents “Tunnel, Link Sewers and Shafts – Settlement Assessment” (DSCIN-DEL-REP-T-J-100252) and “Combined Settlement Report for the Link Sewers” (DSLSC-DEL-REP-GT-J-100262) which have highlighted the methodologies and assumptions used in the analyses.

### 2. Scope

The scope of this memorandum is to demonstrate that total settlement and differential settlement for the revised tunnel alignments comply with the consent conditions [Resource Consent 40836 condition 4.33]. The consent limit for total settlement is 50mm and differential settlement is limited to 1:1000.

### 3. Main Tunnel

#### 3.1 *Balfron Ave to May Rd : Ch 16+700 – 17+650*

The detail design tunnel alignment has moved horizontally outside the consented boundary between Ch 16+700 to Ch 17+650 (May Rd site). The maximum horizontal variance is approximately 75m to the south west circa Ch 17+350 as shown on Drg 2012064.029.

The geological section is shown in Drg 2012061.021 and indicates that the tunnel will be developed at least 65m below ground surface in ECBF rock. The overlying materials of the revised alignment are as per the consented alignment except that there is a greater interval of Tauranga Group alluvium from Ch 17+300 to Ch 17+600.

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The detail design estimates of settlement for the tunnel indicate <5mm movement at the surface, which is considered negligible and significantly less than the consented maximum of 50mm. Differential settlement is predicted to be less than 1:2440 and will therefore comply with the consented differential settle limit of 1:1000.

### 3.2 Chamberlain Park to Western Springs : Ch 22+480 – 22+900

The detail design tunnel alignment passes approximately 40m west of the consented corridor under the motorway and gradually returns to the consented corridor at the north eastern boundary of the MOTAT site as shown on Drg 2012064.026.

The geology through this section is shown in Drg 2012061.025 and comprises a variable thickness of competent basalt from surface to the underlying ECBF. The interpreted geological conditions of the revised alignment are essentially the same as for the original alignment and the tunnel is to be developed entirely within ECBF. Groundwater take is to be managed through this section by the use of closed face operating mode for the tunnel boring machine. The implications for groundwater drawdown and induced settlements due to tunnel construction are considered to be no different from those assessed for the original consent. Settlements for the revised alignment are predicted to be less than 5mm, which complies with the 50mm permitted under the consent. Differential settlement is predicted to be less than 1:2440 and will therefore comply with the consented differential settle limit of 1:1000.

## 4. Link Sewer C : Ch 0+100 – 3+250

The revised alignment developed during detail design is vertically some 16m higher than considered in the consent and is horizontally outside the consented boundary from May Rd to approximate Ch 750 and from Ch 3+100 to PS25. The plan variances are shown on Drg 2012064.033 while the vertical variance is shown on Drg 2012064.022.

The geology along Link Sewer C is shown on drawings Drg 2012004.001, 002 & 003. The ground profile comprises variable thicknesses of basalt and alluvium at surface over ECBF rock. The tunnel will be developed in ECBF rock from May Rd to Miranda Reserve where it will transition into residual soil of the ECBF and Tauranga Group alluvium near PS25.

Four chainages along Link Sewer C have been identified as areas of interest : Ch 0+350, Ch 1+300, Ch 3+050 and Ch 3+200 from the start of Link Sewer C at May Road. The elevations of the revised and original consented Link Sewer C locations are highlighted in the table below:

Table 1 Elevations at critical chainages

Chainage	Reduced Level (m)	
	Revised RL	Original Consented RL
350	-5m	-21m
1300	-3m	-19m
3050	1m	-17m
3200	1.5m	-17m

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The detail design calculations included consideration of groundwater drawdown and mechanically induced settlement which may occur during tunnel construction.

## *Indirect dewatering induced surface movement*

The groundwater drawdown settlement for Ch 0+350, Ch 1+300, Ch 3+050 and Ch 3+200 are summarised in the table below. The majority of the settlement was found to be due to the groundwater drawdown, and the mechanical settlement was found to be a minor (<5mm) component of the total drawdown until Link Sewer C neared the surface (at Ch 3+050 where tunnel was approximately 6m bgl). The groundwater drawdown was greatest at Ch1+300, and this was reflected by having the largest settlement (13mm). Ch 1+300's relatively larger settlement compared to the other two locations was also due to the thicker compressible TGA layer above the tunnel (14m thick compared to 6m at Ch3+200 and no TGA at CH350), as the TGA is known to have a much lower Young's modulus compared to the ECBF residual soils and rock.

**Table 2 Summary of total and differential settlement of combined settlements**

Chainage section	Max settlement (mm)	Max differential settlement
Ch 0+350	7	1 in 12,500
Ch 1+300	14	1 in 6,000
Ch 3+050	7	1 in 875
Ch 3+200	10	1 in 1,100

The implications for groundwater drawdown and induced settlements due to tunnel construction are considered to be no different from those assessed for the original consent. The total settlements along Link Sewer C are predicted to be within the consent limit of 50mm. The out-of-limit differential settlement at Ch 3050 occurs under open parkland and is therefore not considered to be an issue to adjacent structures; it will be imperceptible given the total ground movement is less than 10mm.

## 5. Conclusions

Based on the results of the analyses of the tunnel induced ground movements and indirect dewatering induced surface movement, we make the following conclusions and recommendations:

- The ground conditions and predicted settlements associated with the revised horizontal alignments of the main tunnel near May Rd and Western Springs are not materially different from those approved in the original consent. Total and differential settlements are expected to be <5mm and 1:2,440 respectively.
- Total and differential settlements predicted for Link Sewer C are generally significantly less than the Consent limits of 50mm total and 1:1000 differential settlement. Differential settlement is within consent limits with an exception circa Ch 3+050 in an area of parkland, where the exceedance of differential settlement of 1:875 is expected to be imperceptible.

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- Our assessment is that the detail design alignments will not cause effects that are materially different from those approved in the original consents.