

HERNE BAY COLLECTOR
T&T-HBC-RPT-00008_3

HBC MH02 SHAFT RELOCATION S127 GROUNDWATER AND SETTLEMENT ASSESSMENT

Issued for Use

Review and Approval

FUNCTION	POSITION	NAME	SIGNATURE	DATE
PREPARED BY	TONKIN & TAYLOR			24/06/2026
APPROVED BY	Ghella Ltd Social Responsibility Manager	Sandra Edwards	Sandra Edwards - GHELLA LTD Jun 24, 2026, 11:30 AM GMT+12:00	

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Revision Status

REVISION	DATE	STATUS	AMENDMENT DESCRIPTION
3.0	24/06/2026`	For Use	Issued for Use – to be issued to council

Revision changes and reviews are required when significant changes have been made to the document, in particular when in response to comments received from Watercare, changes in contractual or Project requirements need to be reflected, or in response to an incident.

24 June 2026
Job No: 0030552.9089

Ghella Limited
Level 1, 8 Gloucester Park Road
Onehunga
Auckland 1061

Attention: Sandra Edwards

Dear Sandra

Herne Bay Collector s127 application for relocation of Shaft MH02 Groundwater and settlement effects assessment

1 Updates to this report

This letter supersedes our earlier report of 3 June 2026, and provides correction of a numerical error, and adds section 3.3 to clarify settlement estimates for the 37 Sarsfield St property.

2 Introduction and background

This report has been prepared for Ghella Limited, to assess the potential groundwater and settlement effects associated with the proposed relocation of the Herne Bay Collector Shaft MH02 and the resulting minor amendment to the Herne Bay Collector tunnel alignment. The assessment is provided in support of a section 127 application under the Resource Management Act 1991 (RMA) to vary Condition 1 of existing resource consent BUN60420393.

The purpose of this assessment is to confirm whether the amended shaft and tunnel alignment gives rise to any material change in groundwater and settlement effects compared with those previously assessed and consented, and whether the existing envelope of effects and consent conditions remain fit for purpose.

Since the granting of the original consent, the design has been refined to relocate Shaft MH02 from the road reserve 9.3 metres northwards to the south-western corner of Point Erin Park, as shown on the site plan enclosed in Appendix A. The relocation is understood to provide construction efficiencies and reduced traffic disruption compared with the originally consented arrangement. In addition, the shaft internal diameter decreases from 13 m to 7 m.

As a result of the shaft relocation, the Herne Bay Collector tunnel alignment has been adjusted. The amended alignment now passes beneath the corner of the property located at 37 Sarsfield Street (also known as 70 Curran Street). At this location, the tunnel is understood to be approximately 13 m below ground level, and written approval has been obtained from the affected landowner.

The previous Groundwater and Settlement Effects Assessment (GSEA)¹ has been used to help compare shaft and tunnelling construction effects.

3 Groundwater and settlement effects

3.1 MH02 relocation

As described in Section 1, the revised proposal does not result in an increase in shaft dimensions relative to those assessed under the existing consent; the shaft size (diameter) notably decreases. The shaft footprint and depth therefore remain within the limits previously assessed, and the construction methodology (secant piling) is provided for within the consent documentation. Accordingly, the magnitude of groundwater and settlement effects associated with shaft construction is not expected to increase because of the relocation.

The primary change arising from the relocation of MH02 relates to the distance between the shaft and surrounding properties, rather than any change in construction scale or method. To assess the implications of this shift, predicted total and differential settlements for nearby properties have been compared against those previously assessed in the consent documentation.

The estimated total combined settlement modelled for MH02 in the original GSEA is shown in Figure 3.1, plotted as estimated ground surface settlement vs distance from the shaft walls.



Figure 3.1: Estimated combined settlement profile due to main shaft excavation (September 2023 GSEA). Note that this plot does not take into account any effects due to tunnelling.

A summary of the potential effects on neighbouring buildings in terms of total and differential settlement is presented in Table 3.1, for the main shaft. Property addresses are shown on Figure 1, Appendix A.

¹ T+T (September 2023). Herne Bay Connector Project – Groundwater and Settlement Assessment Report. Ref: 1090120.0000 v4.

Table 3.1: Settlements due to Shaft MH02 (not including effects from the tunnel)

Consenting assessment	Nearby properties	Distance from shaft		Settlements	
		Point 1 (1)	Point 2 (2)	Max Total	Max Differential
Consented MH02	30 Sarsfield Street	17.5 m	20.0 m	Less than 2 mm	1 (V): 3450 (H)
	28 Sarsfield Street	18.5 m	20.0 m	Less than 2 mm	1 (V): 3500 (H)
	37 Sarsfield Street	25.5 m	29.5 m	Less than 1 mm	1 (V): 10700 (H)
Relocation of MH02	30 Sarsfield Street	27.0 m	29.5 m	Less than 1 mm	1 (V): 10700 (H)
	28 Sarsfield Street	29.5 m	30.5 m	Less than 1 mm	1 (V): 5000 (H)
	37 Sarsfield Street	24.0 m	29.5 m	Less than 1 mm	1 (V): 10700 (H)
Notes	(1)	This is the closest point of the assessed building to the shaft excavation.			
	(2)	This is the maximum differential settlement point across the building footprint.			

A summary of potential effects of the MH02 shaft on neighbouring buildings in terms of total and differential settlement is presented in Table 3.1, for the main shaft. Property addresses are shown on Figure 1, Appendix A.

As shown in Table 3.1, the change in effects on nearby properties is negligible. Accordingly, the relocation of MH02 does not result in any material change to groundwater or settlement effects associated with shaft construction, and the overall effects remain **less than minor**. No changes to the existing consent conditions are therefore required.

Note that the settlement effects presented above are due to the shaft only; they do not include effects of the Herne Bay Collector Tunnel itself (discussed below).

3.2 Tunnelling effects

3.2.1 Background

The original Groundwater and Settlement Effects Assessment (GSEA) assessed tunnelling-related settlements for an alignment that was entirely located within the Sarsfield Street Road reserve. As a result, the predicted settlement profile adopted for tunnelling was conservative with respect to potential effects on buildings, as the full extent of settlement was expected to occur within the road corridor, away from building footprints.

With the amended design, a short section of the tunnel alignment now passes beneath the corner of the property at 37 Sarsfield Street (also known as 70 Curran Street). Consequently, a more refined assessment of total tunnelling related settlement has been undertaken to better characterise potential effects beneath this property. This refined assessment considers both dewatering-induced settlement and mechanically induced settlement associated with tunnel construction.

3.2.2 Hydrological setting

Groundwater conditions in the Herne Bay / Point Erin area are well characterised through project-related monitoring to date and comprise a shallow perched groundwater system within the near-surface soils and a deeper groundwater system within the underlying East Coast Bays Formation (ECBF) rock.

This conceptual groundwater model is supported by multi-level vibrating wire piezometer (VWP) data from monitoring location HBS1-01 (location shown in Appendix A), which includes four VWPs installed at depths of approximately 5 m, 10.5 m, 15 m, and 21 m below ground level. Monitoring during construction of the Central Interceptor (CI) tunnel as it advanced toward Point Erin Park between approximately July and October 2025 recorded clear, depth-dependent groundwater responses to the tunnel construction.

Significant groundwater drawdown was observed in VWPs screened at 10.5 m bgl and deeper, corresponding to the ECBF groundwater system, while the shallow VWP at 5 m bgl within the Takanini Formation showed no measurable response to the tunnelling. This confirms that tunnelling, which occurred entirely within the ECBF rock, induced drawdown only within the deeper groundwater system (as expected). This is a commonly observed phenomenon at the large majority of excavations across Auckland.

Figure 3.2 presents the groundwater level time series for the four VWPs at HBS1-01 and demonstrates the hydraulic separation between the shallow perched groundwater system and the deeper ECBF groundwater system.

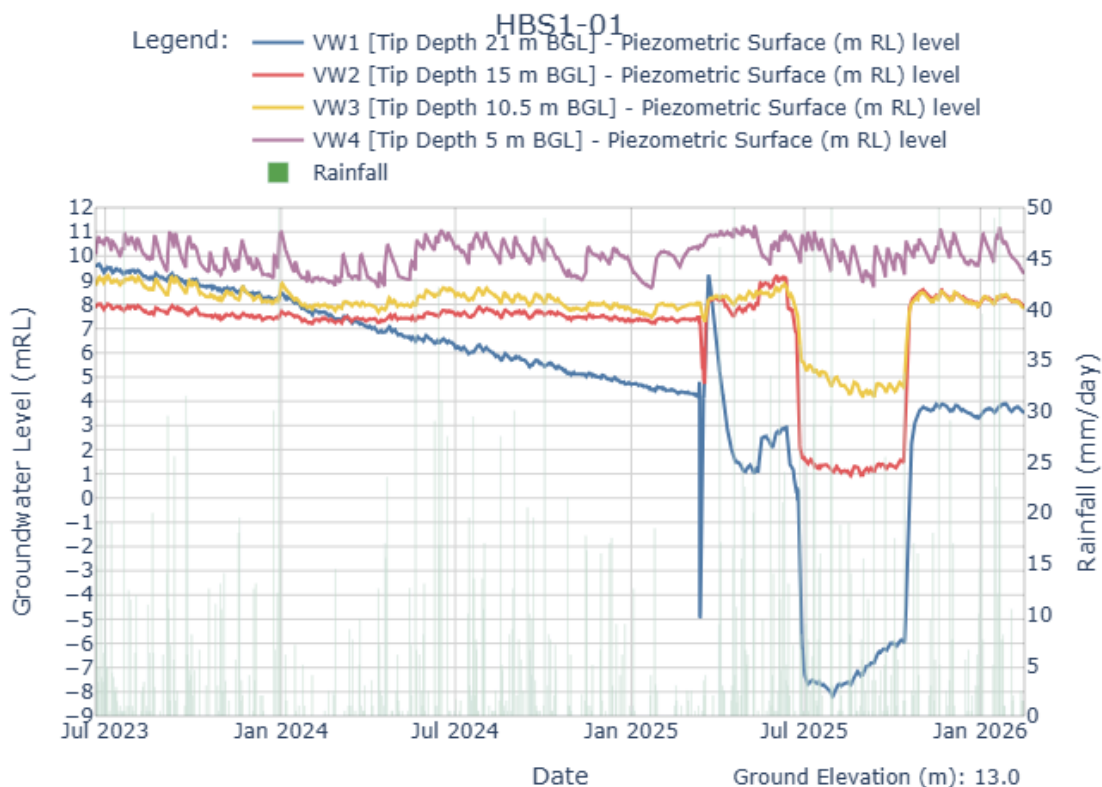


Figure 3.2: Recorded groundwater information from HBS1-01. Located on Sarsfield Street across from intersection with Curran Street.

Based on the recognised separation between the shallow perched groundwater system and the deeper ECBF groundwater system, negligible groundwater drawdown is expected within the upper, compressible soils of the Takaanini Formation. Accordingly, groundwater-related settlement within these upper materials is anticipated to be negligible. However, for conservatism, the following sections present the groundwater drawdown and settlement assessment assuming a single, fully hydraulically connected groundwater system.

3.2.3 Conservation assessment of dewatering-induced settlement

A conservative assessment of tunnelling-related dewatering can be taken by analysing a SEEP/W² model with the new section orthogonal to the tunnel centreline across the property, at the location shown on Figure 1 in Appendix A. The SEEP/W model uses the same geotechnical and hydrogeological parameters used within the September 2023 GSEA¹, with groundwater pressures estimated from the nearby investigations shown in Appendix A.

The groundwater model before and after tunnelling is presented in Figure 3.3 and Figure 3.4 respectively, below. The reductions in pore water pressure are used to calculate dewatering-induced settlement, the results of which are shown in Figure 3.5.

The maximum settlement directly over the tunnel centreline reaches approximately 4 mm.

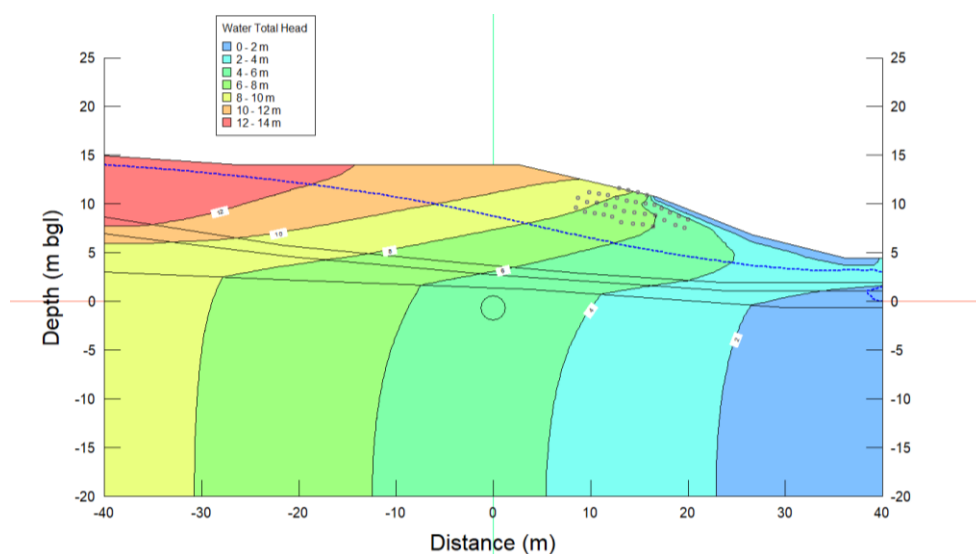


Figure 3.3: Groundwater model at cross section C-D (location shown in Appendix A), showing the steady state initial conditions prior to tunnelling.

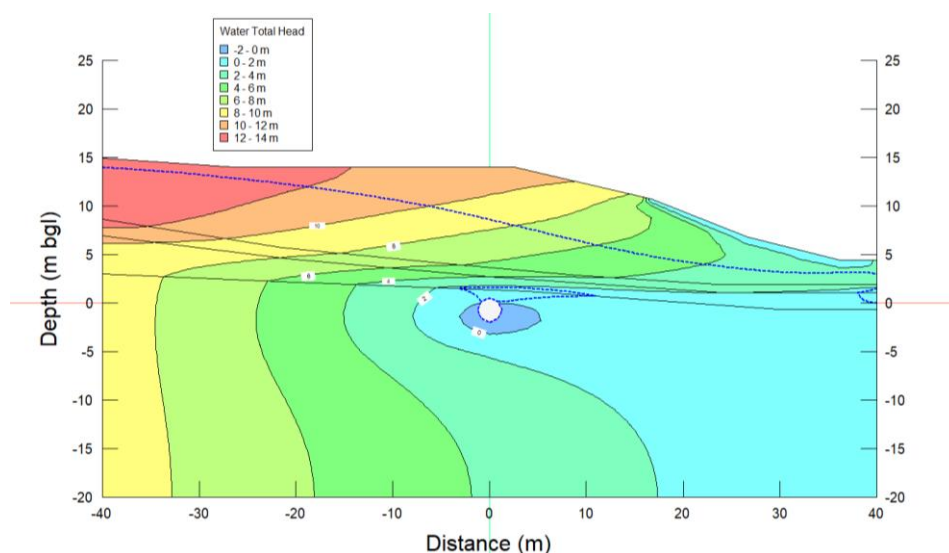


Figure 3.4: Groundwater model, 7 days after tunnelling. The reductions in pore water pressure compared to Figure 3.3 are used to calculate consolidation settlement.

² GeoStudio 2025.2.1. SEEP/W

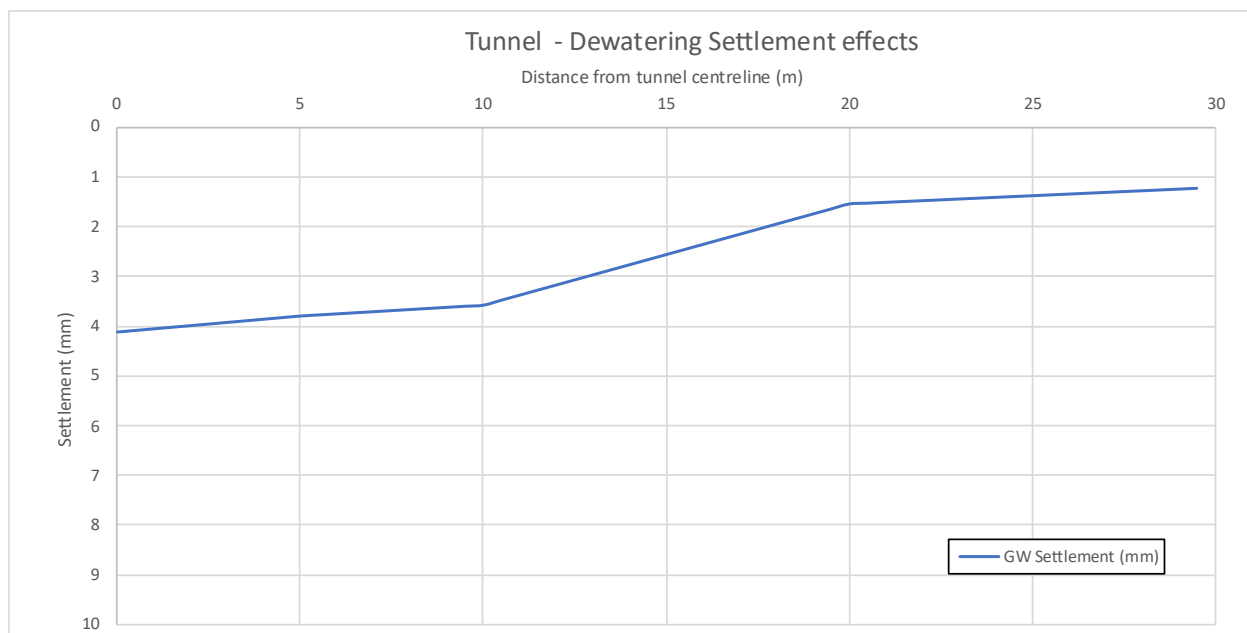


Figure 3.5: Modelled settlement profile due to the tunnel dewatering.

3.2.4 Mechanical settlement due to tunnelling

As shown in the ground model presented in Appendix A, the tunnel alignment beneath 37 Sarsfield Street is entirely within the East Coast Bays Formation (ECBF) rock.

The method of New and O'Reilly (1982) has been used to assess the maximum magnitude and lateral extent of mechanically induced ground settlement due to construction of the proposed sewer tunnel. This method is widely adopted for estimating surface settlement effects associated with tunnelling and is considered appropriate for the geological conditions encountered at this location.

The parameters adopted for the mechanical settlement assessment are summarised in Table 3.2, including tunnel diameter, depth to tunnel axis, assumed volume loss, and ground loss distribution. Based on these parameters, the predicted mechanically induced settlement trough has been developed and is shown in Figure 3.6.

Table 3.2: Parameters adopted for assessing settlement due to tunnelling volume loss

Parameter	ECBF Rock
Diameter (m)	2.5
Depth to tunnel axis (m)	14.7
Volume loss (%)	0.5
Trough width factor, K	0.5

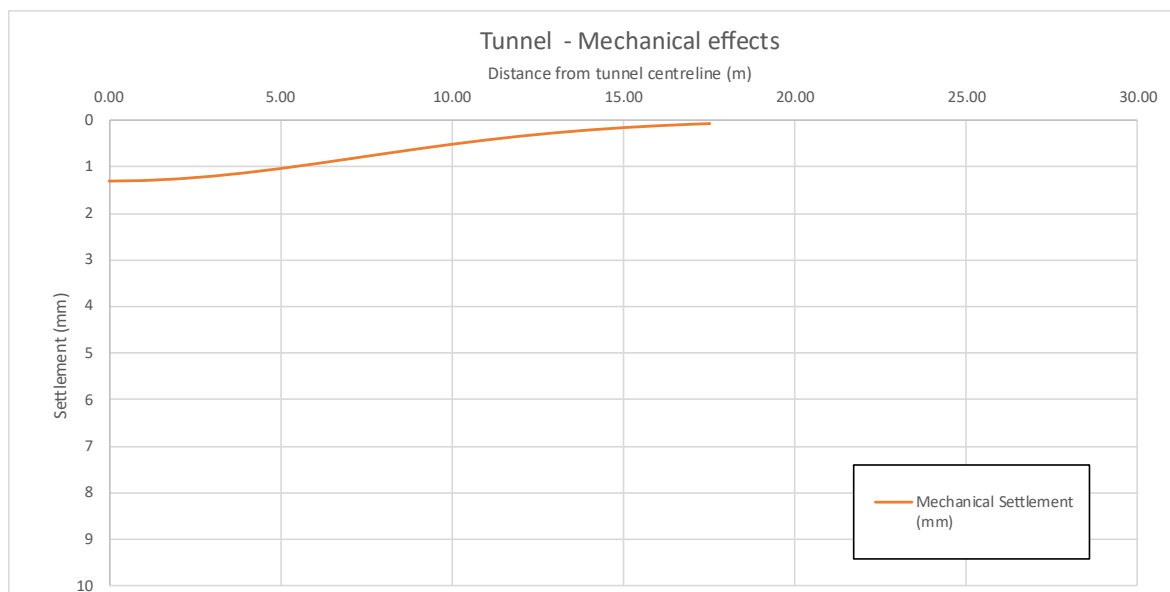


Figure 3.6: Ground surface settlement profiles from the tunnel centreline for mechanical-induced settlement.

3.2.5 Combined settlement effects due to tunnelling

The total tunnelling-related settlement has been determined by combining the dewatering-induced settlement profile with the mechanically induced settlement profile. The resulting combined settlement profile beneath 37 Sarsfield Street is shown in Figure 3.7.

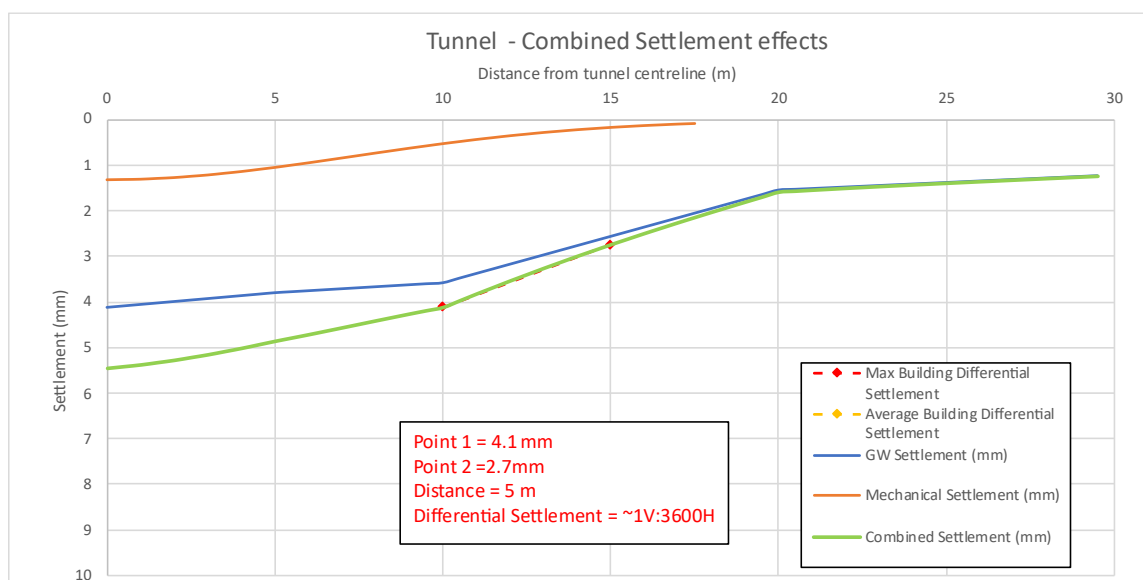


Figure 3.7: Total combined ground surface settlement profiles from the tunnel centreline.

Based on this conservative combined settlement assessment, the maximum predicted total settlement at the corner of the subject property is approximately 5 to 6 mm, with a maximum predicted differential settlement of approximately 1 (V): 3600 across the building footprint. Actual effects are expected to be less for the reasons presented in section 3.2.2 above.

The amended tunnel alignment does not change the tunnelling-related settlement effects that were originally assessed. The magnitude of effects remains **less than minor**, and the existing consenting framework and conditions remain appropriate and unchanged.

3.3 Combined settlement at 37 Sarsfield Street due to shaft and tunnel

As shown in section 3.1 of this report, the relocated MH02 shaft is 24 metres from the dwelling at 37 Sarsfield Street, and construction of the shaft is expected to cause less than 1 mm of settlement.

The tunnel passes close by the southeastern corner of the dwelling, and is conservatively estimated to cause less than 6 mm of settlement.

The combined settlement affecting the southeastern corner of the dwelling is therefore conservatively estimated to be up to 6 mm (likely less than 2 mm when accounting for separation of deep and shallow groundwater systems). Differential settlements across the dwelling are conservatively estimated to be less severe than 1V:3600H, and more likely to be in the order of 1V:10,000H when accounting for separation of groundwater systems (i.e. differential settlements are more likely to be due to natural fluctuations in soil moisture and survey error).

4 Summary and conclusions

This assessment has reviewed the groundwater and settlement effects associated with the proposed relocation of Shaft MH02 and the amended tunnel alignment.

- The relocated shaft is slightly closer to 37 Sarsfield Street, and the collector tunnel now crosses beneath the corner of this property.
- Geotechnical and groundwater effects due to the shaft are still calculated to result in less than 1 mm of settlement to neighbouring buildings at 26, 28, 30 & 37 Sarsfield Street; i.e. **less than minor** effects.
- A conservative assessment of combined shaft and tunnelling effects indicates that total settlement of less than 6 mm (i.e. **less than minor**) may affect 37 Sarsfield Street; however, construction monitoring of the Central Interceptor tunnel nearby indicates that settlements will actually be significantly less than this.

Overall, effects remain less than minor, and existing consent conditions remain appropriate.

5 Applicability

This report has been prepared for the exclusive use of our client Ghella Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by: Noah Hinds – Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



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Karen Baverstock
Project Director

Report reviewed by Mark Thomas (Senior Principal Geotechnical Engineer).

24-Jun-26

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gsea report rev4 23.06.26.docx

Appendix A Figures

- **Overall site plan**
- **Ground Model – Section A-B (Parallel with tunnel)**
- **Ground Model – Section C-D (Orthogonal with tunnel)**



Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

Notes and data attributions goes here.

0	First version	NOHI	MRT	MAY.26
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REV	DESCRIPTION	GIS	CHK	DATE
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LOCATION PLAN

PROJECT No. 30552.9089

DESIGNED	NOHI	MAY.26
DRAWN	NOHI	MAY.26
CHECKED	MRT	MAY.26

APPROVED	DATE
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CLIENT GHELLA LMITIED

PROJECT HERNE BAY COLLECTED S127

TITLE OVERALL SITE PLAN

SCALE (A3) 1:750

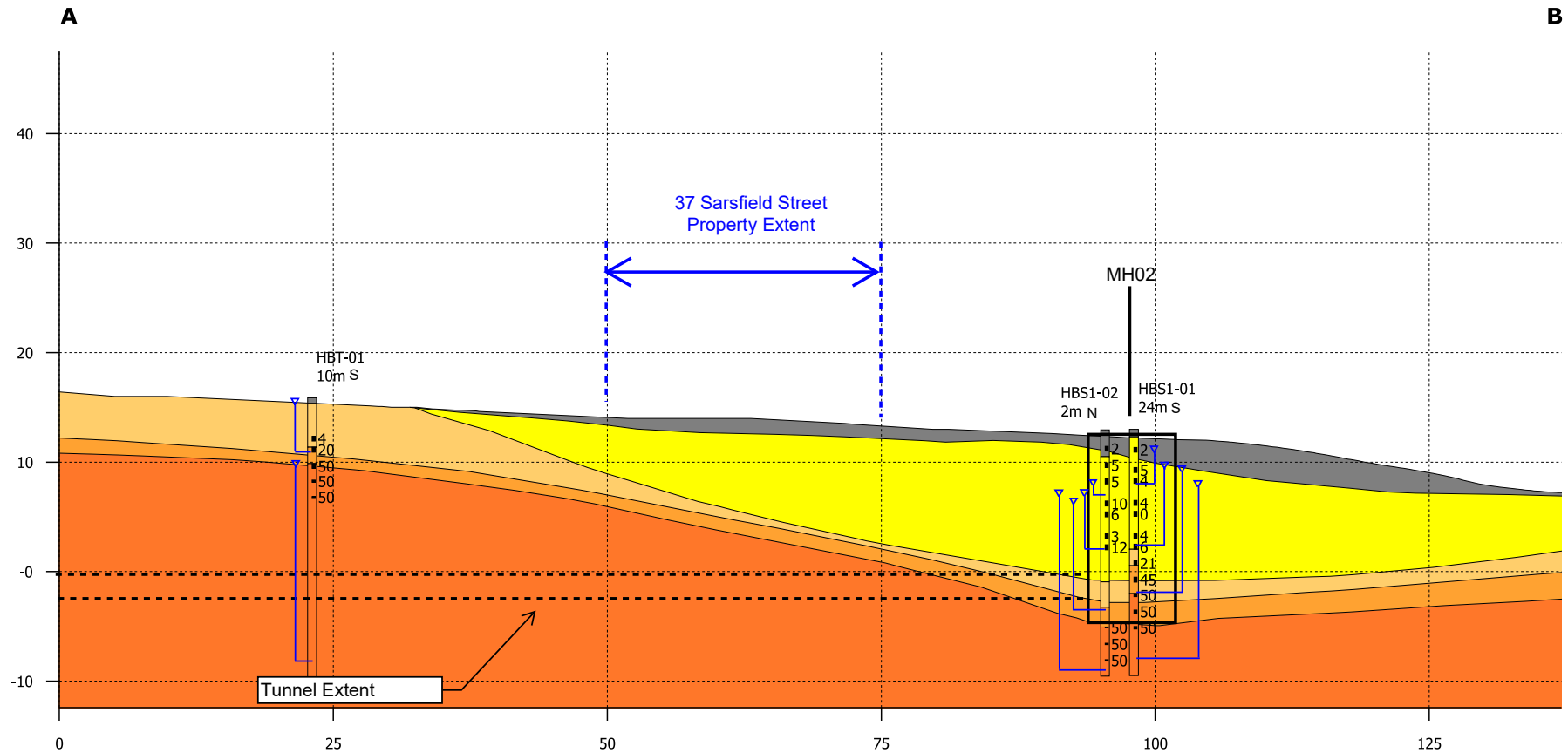
FIG No. FIGURE 1.

REV 0

FIGURE 2

Herne Bay - MH02 Relocation
Section A-B

WEST **EAST**



Legend

UNIT

- Fill
- East Coast Bays Formation (Residual soil)
- East Coast Bays Formation (SPT N = 50+)
- Takanini Formation
- Recorded VWP Groundwater Level (Winter High)

Location

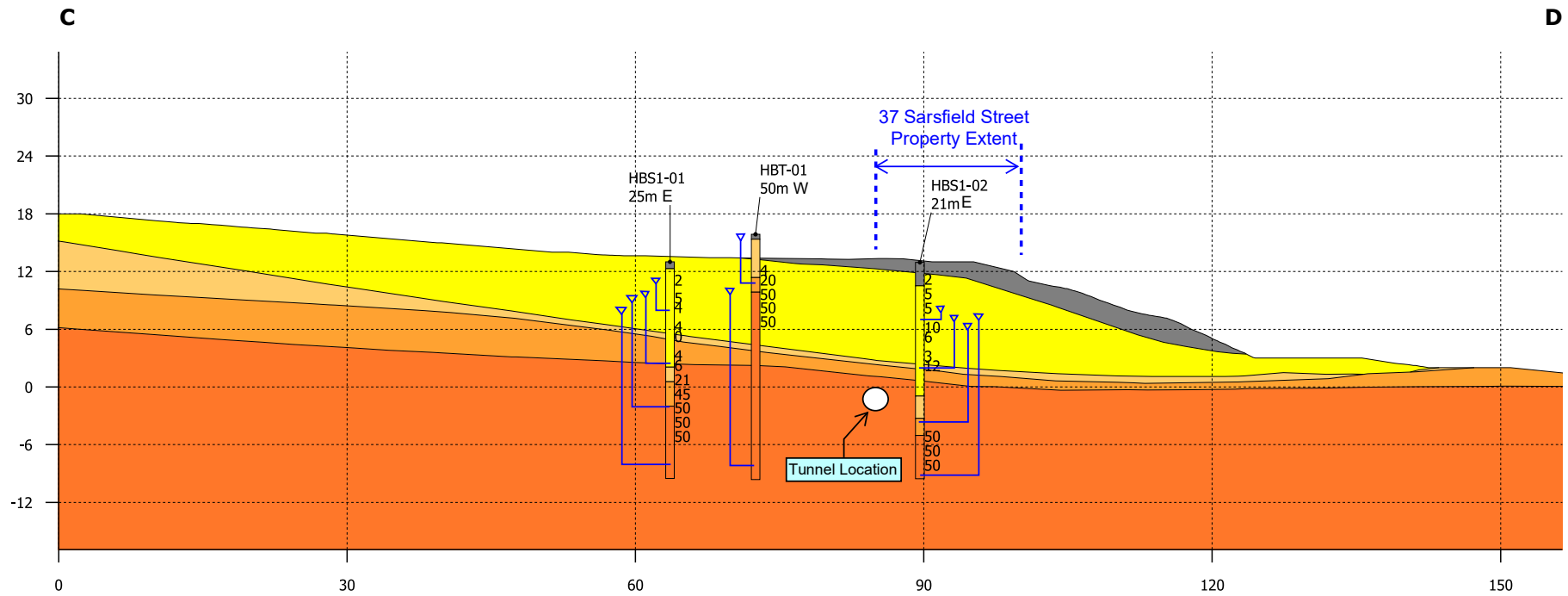
A: 1755027, 5921348
 B: 1755153, 5921401

Scale: 1:400
 Vertical exaggeration: 1x



**Herne Bay - MH02 Relocation
Section C-D**

SOUTH **NORTH**



UNIT

- Fill
- East Coast Bays Formation (Weathered)
- East Coast Bays Formation (Residual soil)
- Takanini Formation
- East Coast Bays Formation (SPT N = 50+)
- Recorded VWP Groundwater Level (Winter High)

Legend

Location

A: 1755123, 5921296
B: 1755072, 5921444

Scale: 1:450

Vertical exaggeration: 1x



Appendix B Groundwater feedback update

Appendix Table B1: Groundwater feedback action table

No.	Early review comments from AC Groundwater Specialist	Location of report updates
1	It is noted that throughout the document titled “Herne Bay Connector Project – Groundwater and Settlement Assessment Report,” prepared by T & T, dated 27 September 2023, Job no. 1090120.0000 v4, the shaft in Sarsfield Street is identified as Shaft 1 - Point Erin, however “The s127 T & T Report” refers to this shaft as MH02. Please provide clarification.	No changes
2	Details of any changes proposed to the General Conditions and the Water Permit Conditions 78 to 109 in the Decision dated 27 March 2024 need to be provided in the report. Particular attention must be given to any changes to Conditions 84, 89 and 90 (for 37 Sarsfield Street a.k.a. 70 Curran Street) and if no changes are proposed, then the report should provide justification as to why.	s127 AEE Section 3.2
3	In relation to the property at 37 Sarsfield Street (70 Curran Street), Section 1 in “The s127 T & T Report” states : “ written approval has been obtained from the affected landowner.” A copy of this approval must be provided, together with evidence that the property owner has sighted the most update assessment and drawings.	s127 AEE Appendix G
4	Please confirm how the ground model presented in geological long-section A-B was determined and update the section and Figure 1 with relevant boreholes and provide the logs in an Appendix. In addition, please provide the measured ground water levels on the long -section. This is important because the long-section indicates that the tunnel is wholly within ECBF rock under the property at 37 Sarsfield. It is expected that the findings of a machine borehole on Sarsfield Street outside 37 Sarsfield Street (or nearby) which informs the depth and thickness of the Takanini Formation that is shown on the long section A-B will be provided.	Appendix A Figure 2 & Figure 3.
5	The settlement profile presented in Figure 2.1 in “The s127 T & T Report” titled “Estimated combined settlement profile due to main shaft excavation (September 2023 GSEA)” appears to be slightly different from Figure 8.1 in the “Herne Bay Connector Project – Groundwater and Settlement Assessment Report,” prepared by T & T, dated 27 September 2023, Job no. 1090120.0000 v4. Please provide clarification.	No changes
6	Note (2) on Table 2.1 indicates that point 2 is “.. taken as an arbitrary 6m distance from point 1 to find the differential settlement.” The resulting calculation of differential settlement presented in Table 2.1 is not appropriate. The maximum predicted differential settlement is required and should be measured from the total settlement profile at the steepest gradient under each dwelling and the calculation provided and the value determined must be assessed.	Section 2.1 (Table 2.1)
7	Please clarify the need for Note (3) on Table 2.1.	Table 2.1
8	Please clarify the source of the settlement profile presented in Figure 2.3 in “The s127 T & T Report. ” If it is copied from Figure 6.4 titled “Ground surface settlement profile due to	Section 2.2.3 & Section 2.2.5.

No.	Early review comments from AC Groundwater Specialist	Location of report updates
	tunnel dewatering (tunnel approximately 20 m bgl)", please clarify the relevance in relation to the dwelling at 37 Sarsfield Street given that Section 1 of "The s127 T & T Report" states : "At this location, the tunnel is understood to be approximately 13 m below ground level".	
9	Please annotate Figure 2.5 to show the maximum predicted differential settlement due to tunnelling at 37 Sarsfield Street and provide the calculation.	Section 2.2.5 and Figure 2.7.
10	The property extent shown on Figure 1 titled "Overall Site Plan" does not match the 25m property extent show on Section A-B. Please provide clarification. Please also label which property on Section A-B	Section 2.2.5 and Figure 2.7.
11	Please update Figure 1 of 17, titled "Ground Settlement Monitoring Plan" in the GSMCP dated October 2023, with the new location of the shaft and any additional settlement monitoring and show the revised settlement contours.	n/a
12	Consideration must be given to the settlement monitoring and pre and post construction detailed condition surveys of the dwelling at 72 Curran Street and justification provided if settlement monitoring and pre and post construction detailed condition surveys are not proposed.	n/a