Determination 2016/028[1]

Regarding the authority's exercise of its powers in issuing a code compliance certificate for a retaining wall at 46 Foyle Street, Ohakune

Summary

The owner of an adjacent property who was of the view that the retaining wall and site works did not comply with the Building Code sought this determination. The determination discusses the various methods used to analyse the compliance of the retaining wall and considers the design parameters and forces that need to be taken into account in assessing compliance.

1. The matter to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004[2] ("the Act") made under due authorisation by me, John Gardiner, Manager Determinations and Assurance, Ministry of Business, Innovation and Employment ("the Ministry"), for and on behalf of the Chief Executive of the Ministry.

1.2 The parties to the determination are:

- the owner of the property at 46 Foyle Street, S Lindsey ("the owner") acting through a lawyer
- the neighbours, P Ryan, D Chung and G Knights ("the applicants") who own an adjacent property at 163 Miro Street
- Ruapehu District Council ("the authority"), carrying out its duties as a territorial authority or building consent authority, acting through a lawyer.

[1] Subject to a clarification under section 189 of the Building Act 2004

[2] The Building Act, Building Code, compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.building.govt.nz or by contacting the Ministry on 0800 242 243.

1.3 This determination arises from the construction of a retaining wall on or near the boundary of the owner's and the applicants' properties. The retaining wall was built under an amendment to a building consent (the building consent together with the amendment will be referred to as "the building consent" for the purposes of this determination). The authority has issued a code compliance certificate for the retaining wall. The applicants believe the retaining wall and associated site works do not comply with the Building Code.

1.4 The matters to be determined[3] are therefore:

- whether the authority correctly exercised its powers in issuing a code compliance certificate for the retaining wall
- whether the retaining wall, as constructed, complies with the Building Code, specifically Clauses B1, B2 and E1.

1.5 I note that any matters relating to the *Resource Management Act 1991* or proceedings in the Environment Court do not fall within the jurisdiction of the Act and are therefore excluded from this determination.

1.6 The applicants have also sought to determine whether the retaining wall complies with Clause F4 Safety from falling. However, as the applicants are a party to the determination under section 176(e)(i), the determination must relate to those clauses of the Building Code that have the purpose of protecting other property, being the applicants' property. I consider that compliance with Clause F4 falls outside the matters the applicants can be a party to and able to have determined, as it does not relate to the protection of their property.

1.7 In this determination, unless otherwise stated, references to sections are to sections of the Act and references to clauses are to clauses of the Building Code.

1.8 In making my decision, I have considered the submissions of the parties, the reports and comments of the expert commissioned by the Ministry to advise on this dispute ("the expert"), and the other evidence in this matter.

2. The building work

2.1 The building work consists of a timber pole retaining wall ("the retaining wall") extending along the boundary between the owner's and the applicants' properties. It is unclear exactly when the retaining wall was substantially constructed, although it appears this was sometime after the building consent was issued in September 2006, and before 2010.

2.2 The site is covered by a thick layer of grass and scrub. The retaining wall is located along the southwest boundary of the owner's property and has been used to raise the ground up on that property. A vehicle access way on the owner's property is located approximately 10m northwest of the wall as shown in Figure 1. Houses are located on the property to the north of the access way.

2.3 The construction details for the retaining wall, as submitted with the application for building consent, are contained in a drawing attached to a Producer Statement – Design ("PS1") dated 15 June 2006. The drawing shows '250 SED[4] H5 [posts] @ 1200 crs in 600 diam x 2200 concrete footings' with the maximum retained height

[3] Under sections s177(1)(a) , s177(1)(b) and s177(2)(d) of the Act
[4] SED – small end diameter

noted as being 1800mm. The posts are shown to be installed with a back slope from vertical of 1 in 20, i.e. approximately 3° off vertical (typical).

2.4 The drawing also shows 200x50mm H5 horizontal planking behind the posts, with 200mm thick 'AP20 scoria' located behind the planks. The ground behind the retaining wall is shown as benched with 300–800mm diameter boulders 'bedded and interlocked' along the first two of the three benches shown. The drawing says the boulders are 'not part of the building consent'.

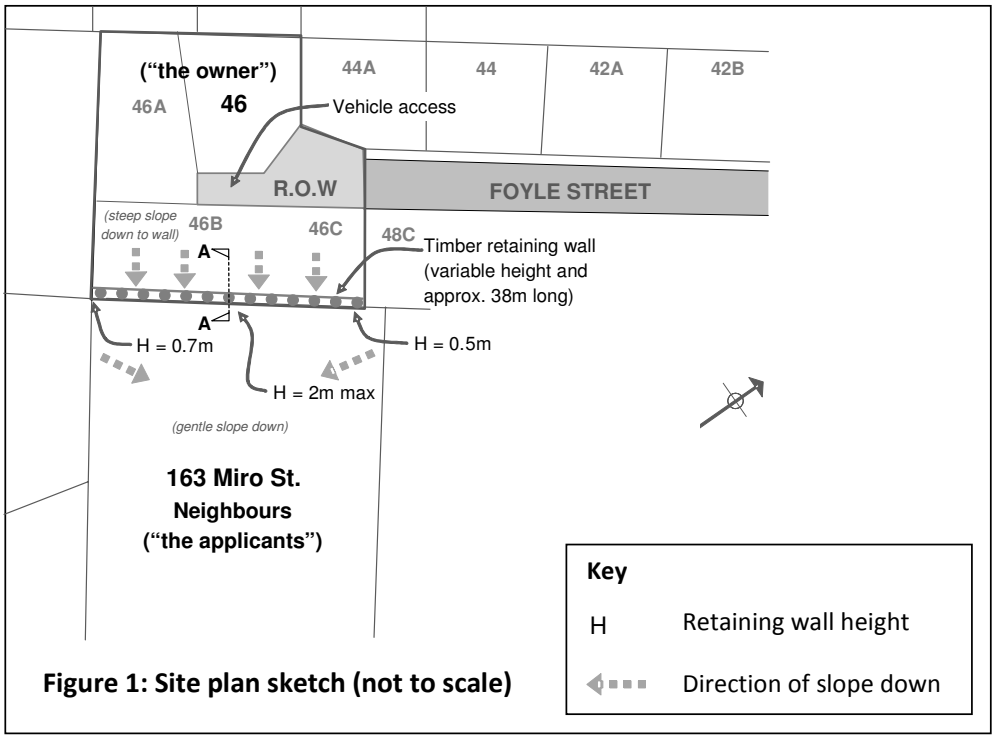

Figure 1: Site plan sketch (not to scale)

2.5 The consented plans appear to show the outer edge of the concrete embedment at the base of the posts located against or just inside the boundary of the owner's property.

2.6 The as-built retaining wall differs somewhat from the drawings attached to the PS1. A location plan that formed part of the building consent shows the retaining wall running along both the SE and SW portions of the owner's property: the wall has only built along the SE portion.

2.7 The wall as built has a typical maximum height of 1.9m, and varies from 1.9m in the central portion of the wall down to approximately 0.4m at either end. The pole spacing varies from 1.11m to 1.40m centre to centre. The wall back slope varies from 3.4º to 0.3º off vertical. The ground slopes down in front of the base of the wall and is approximately 10º to 15º from horizontal.

2.8 The in-situ material at the site is a type of volcanic ash with minor sand and clays. Site investigations show the fill material to be drainage gravel present in only some locations, with the majority of the fill being gravelly sandy silt to a silt, with the predominate material being silt.

2.9 It appears the posts are smaller at the base of the wall than at the top, which is contrary to normal practice. A few posts appear to have a small end diameter (SED) of less than 250mm. The concrete encasement of the posts is 600mm in diameter, at or near the ground's surface.

2.10 The backfill rises steeply beyond a narrow horizontal bench at the top of the wall. The as built slope is between 31º to 36º (the PS1 shows the slope's surcharge angle as 45º), with a vertical height of between 3.5m and 4.0m.

2.11 The slope at the top of the backfill rises gently, at 2º to 3º, to a sealed right of way. At the time of the expert's site investigation on 8 July 2014, a dwelling was nearing completion on Lot 2 DP 350131 (which I take to be the property at 46A Foyle St).

2.12 On 25 March 2014, the applicants dug an excavation drainage trench near the toe of the wall. On 19 August 2014, the applicants informed the parties that the contractor had "filled in" the excavation drainage trench.

2.13 An extra plank has been placed on top of the existing planks on the wall, resulting in a retained height of more than 2m. The authority has stated the additional plank has been investigated and is a 'temporary addition to enable compliance with erosion and sediment control requirements', but does not consider it affects the compliance of the retaining wall with the Building Code.

2.14 An undisclosed number of weep holes have been installed in the planking. I have not been provided with the number or location of these weep holes. I understand they were made at some stage after the expert's site investigation on 8 July 2014. I also understand the reason for the installation relates to proceedings in the Environment Court.

3. Background

3.1 On 24 July 2006, the authority received an application for building consent from the owner to construct a retaining wall. The application for consent was supported by a PS1 dated 15 June 2006, plus calculations and a drawing.

3.2 On 29 September 2006, the authority issued building consent No. 13757 to the owner for the construction of the retaining wall.

3.3 On 7 March 2014, the applicants commissioned their own geotechnical engineers ("the applicants' engineers") to assess the retaining wall. The applicant's engineers' report concluded the retaining wall lacked any existing drainage measures, did not appear to meet "serviceability requirements", and that the pole embedment was insufficient – i.e. that the embedded pole would continue to rotate in the ground.

3.4 On 12 March 2014, the authority received an application for an amendment to the building consent from the owner. The amended building consent was to 'change 200 x 50 H5 rough sawn' planking to '200 x 50 H5 T&G dressed planking'. The application for amendment was supported by a PS1 dated 8 March 2014, issued in respect of 'Variation No 1: Change planking to T&G 190x45 H5'. Calculations attached to the PS1 concluded 'Planking as-built OK for strength in all cases'.

3.5 On 20 March 2014, the applicants emailed the authority requesting it to issue a notice to fix under section 164(2) of the Act to the owners in respect of the retaining wall. The applicants provided an outline of what they perceived to be the issues with the retaining wall (see paragraph 4.1.1). The applicants alleged building work had been undertaken without the required inspections, and had not been carried out in accordance with the building consent and the approved engineering drawings.

3.6 On 21 March 2014, the authority issued a code compliance certificate to the owner for the retaining wall.

3.7 On 2 April 2014, the applicants emailed the authority regarding the retaining wall's compliance with the Building Code. The applicants then applied for a determination, and this was received by the Ministry on 16 April 2014.

4. The initial submissions

4.1 The applicants

4.1.1 The applicants provided a written submission with their application for determination. The main points of their submission are summarised as follows:

- The retaining wall was not constructed in accordance with the building consent. The planking used is not the type specified on the building consent (original or amended).
- The authority did not inspect the building work in accordance with the building consent.
- The producer statements are incorrect and the code compliance certificate was issued incorrectly. The code compliance certificate was issued over seven years after works were undertaken and does not certify the full extent of the building work.
- With respect to Clause B1 of the Building Code, the planking used for the retaining wall is of a lesser size than that specified in the original building consent documents, the amended consent or the code compliance certificate. The planking has ruptured in parts, has not been joined according to 'good building practice' and has warped.
- With respect to Clause B2 of the Building Code, the planking is not treated to the hazard class specified in the building consent. The warped planking does not satisfy the performance requirements of the Building Code.
- With respect to Clause E1 of the Building Code, the works have not been constructed in such a way as to protect neighbouring property, in that surface water is not controlled.
- The building works as constructed cause a loss of amenity through degradation of the structure, erosion and changes to natural water flows.

4.1.2 On 16 June 2014, the applicants provided further documents, notably expert opinions from various parties relating to the retaining wall. On 18 June 2014, the applicants emailed the authority stating that a comparison of measurements taken in March 2014 and again on 18 June 2014 provided evidence that "the retaining wall was moving and the posts are rotating". This was followed up by an email dated 19 June 2014 to the Ministry confirming the measurements as evidence the retaining wall is rotating and twisting. The applicants noted there was evidence of slumping of the earth bank above the retaining wall, and that the plank ends were not joined properly and appeared to be continuing to deform outwards.

4.1.3 I note the applicants' objections, expressed in emails dated 4 July 2014, to the witness statements provided by the authority relating to Environment Court proceedings being used for the current determination, which is a technical review. I have dealt with these objections in paragraph 4.2.2.

4.1.4 The applicants provided the following documentation with their application:

- Building consent documentation for the retaining wall, including a PS1 dated 15 June 2006.
- Producer Statement PS4 Construction Review ("PS4") forms for the retaining wall dated 23 April 2012 and 11 March 2014.
- Information about the amendment to the building consent in relation to the planking, including a PS1 dated 8 March 2014.
- The code compliance certificate for the retaining wall dated 21 March 2014.
- Various email correspondence between the authority and the applicants, dated between March and April 2014.

4.2 The authority

4.2.1 The authority, acting through a lawyer, submitted the following documents on 4 July 2014:

- statement of evidence from the applicants' geotechnical engineers
- a series of evidence statements and a joint witness statement prepared for related Environment Court proceedings.

4.2.2 I note there was a series of emails between the applicants, the authority and the Ministry regarding the documents provided that relate to Environment Court proceedings. Under section 186(1)(c) I must receive any relevant evidence, whether or not it would be admissible in a court of law. I must assess the relevance of any submissions received in relation to the matter to be determined and take account of these in the determination. I have done so in this case.

5. The expert's first report

5.1 General

5.1.1 As mentioned in paragraph 1.8, I engaged an independent geotechnical expert to assist me. The expert is a member of the Institute of Professional Engineers New Zealand. The expert inspected the retaining wall structure on 8 July 2014, providing a report dated July 2014. The report was provided to the parties on 15 August 2014.

5.1.2 In his first report, the expert assessed the compliance of the retaining wall against B1/VM1 and B1/VM4, as these were the design methods relied on in the PS1 and were current at the time the consent was issued in September 2006. The other Acceptable Solutions and Verification Methods current at the time include B2/AS1 and E1/VM1 in relation to, respectively, Clause B2 Durability and E1 Surface water.

5.2 The as-built variations

5.2.1 The expert noted a number of variations between the as-built retaining wall and the consented works. In summary:

- there was a change in the backfill slope above the retaining wall, which reduced the lateral earth pressures
- the drainage metal behind the wall does not appear to be consistently in place behind the planking and consequently may result in hydrostatic pressures behind the wall increasing the lateral load

- there is a notable ground slope in front of the wall, reducing the capacity of the posts.

5.3 Compliance with Clause B1

5.3.1 In his first report, the expert concluded that the retaining wall, as consented, did not comply with Clause B1 of the Building Code. The expert reached this conclusion having checked the retaining wall using hand calculations following B1/VM1 and B1/VM4. He also used SESOC Soils, a computer program used to check the design of structures in accordance with B1/VM4. The expert stated that both methods gave similar results.

5.3.2 The expert found that, using the methods in B1/VM4, and considering the coefficient of active earth pressure with regard to the backfill slope, the load factor (from B1/VM1) and the strength reduction factors for posts and post groups (from B1/VM4), the retaining wall as constructed had insufficient capacity to resist the lateral loads from the retained slope.

5.3.3 In reaching this decision, the expert noted that there was a fundamental error in the original calculations for the designed wall affecting the pressure on the back of the wall.

5.3.4 The expert also noted the following in relation to the design of the wall as consented ("the consented design").

- The retaining wall has a significant backfill slope and the ground at the top of the slope is likely to have structures built on it. Clause B1 requires all likely physical conditions that affect the stability of buildings to be taken into account.
- No allowance had been made for the fact that the existing ground at the front of the wall sloped downwards in front of the wall.
- The expert considered an appropriate load factor for lateral loads from earth pressures was 1.6 and not 1.4, as stated in the consented design. B1/VM1 required loadings from NZS 4203[5] to be used, and the load factor on earth retaining structures of 1.6 be applied to lateral loads.[6]
- The expert considered the coefficient of active earth pressure for the as-built wall was 0.43, compared to 0.35 applied in the consented design.
- A strength reduction factor for the pole ultimate lateral bearing was taken to be 0.5 and applied to the closely-spaced poles based on the encasement diameter of 0.6m and a pole spacing of 1.2m. No reduction had been applied for closely-spaced piles in the consented design.

5.4 Compliance with Clause B2

5.4.1 The expert noted B2/AS1 cites NZS 3602[7] as an Acceptable Solution for Clause B2 Durability. Timber planking used in this situation is typically treated to H4. However, the tongue and groove timber specified on the amended building consent is

[5] New Zealand Standard NZS 4203: NZS 4203:1992 General structural design and design loadings for buildings. NZS 4203 was the loadings standard current at time that the original wall was designed.
[6] This load factor was a modification to NZS 4203 by B1/VM1 that was in effect at the time the consent was issued. It has since been replaced by the load factors in AS/NZS 1170, referenced by the latest version of B1/VM1.
[7] New Zealand Standard NZS 3602:- Part 1:2003 Timber and Wood-based products for use in buildings.

shown as H5 treated. The expert could not confirm that the planking used was H5, but confirmed that treatment to H4 would be sufficient to satisfy Clause B2. The expert found the planking had sufficient capacity to distribute the anticipated loads when assessed in accordance with the timber design standard (NZS 3606).

5.5 Compliance with Clause E1

5.5.1 The expert concluded the building works and site works do not appear to concentrate surface water, and also do not appear to cause damage or a nuisance. He therefore concluded the wall complied with Clause E1.3.1. He noted that the steep backfill slope is covered in low-growing vegetation, and there does not appear to be any concentration of water from the slope above the retaining wall or behind the retaining wall itself.

6. The party's response to the expert's report, and the expert's additional comments

6.1 The applicants

6.1.1 On 19 September 2014, the applicants provided a written submission in response to the expert's report. The submission also covered matters relating to the code compliance certificate and matters arising from correspondence with the Ministry. The applicants noted that their submission was informed by the opinions of a geotechnical engineer.

6.1.2 On 29 September 2014, the applicants provided a further submission, containing extra information about the matters raised in its and the other parties' submissions.

6.2 The authority

6.2.1 The authority provided a written submission dated 19 September 2014, including three separate statements by an officer of the authority, the authority's engineers and a building consultant. In essence, the authority agreed with the conclusion reached in the expert's report that the retaining wall complied with Clause B2 and Clause E1.3.1. The authority did not accept the expert's report in relation to compliance with Clause B1 and referred to the reliance placed on the PS1.

6.2.2 On 7 October 2014, the authority's lawyer made a further submission responding to the applicants' submissions of 19 and 29 September 2014, and including additional comments from the authority's engineer, and the authority's building consultant.

6.3 The owner

6.3.1 On 19 September 2014, the owner's lawyer provided a report from the owner's engineer dated 12 September 2014, concluding that the as-built retaining wall complies with Clause B1 and that it was 'incumbent upon [the Ministry] to resolve the conflicting positions set out by the various experts.'

6.4 The expert's comments in response to the parties' submissions

6.4.1 On 24 September 2014, I asked the expert to review and respond to the technical matters raised in the further submissions of the parties. This report was provided to the parties on 21 October 2014. The report can be summarised as follows.

- In relation to the as-built building work's compliance with Clause B1, the expert reported his view that the drainage gravel was not continuous or

consistently in place behind the planking. This had been checked with a 2m steel probe at multiple locations.

- In relation to the basis of design, the expert noted that Table 4 in B1/VM4 gives strength reduction factors for deep foundation design and AS/NZS 1170 provides load factors for various load combinations. These load factor values should provide guidance when alternative solutions are proposed. In lieu of effective drainage material behind the wall it is difficult to see how the wall backfill might be considered drained and would be compliant with Clause B1.
- In relation to the building consent documentation provided to the authority, the expert referred to an IPENZ Practice Note regarding producer statements, noting they should not be the sole means by which the authority satisfied itself as to the compliance of the building work. The expert explained why he considered it unreasonable to rely solely on a PS1 for compliance with the Building Code, including:
    - the wall was a boundary between two properties
    - the wall had a very steep backfill slope angle
    - dwellings were proposed at the top of the backfill slope
    - there was no indication of specific ground investigations to confirm soil properties
    - the wall was designed by a sole practitioner
    - the analysis and calculations submitted were brief.
- In response to the authority's engineer's report, the expert stated that the 0.5 strength reduction factor used by the expert applied to the geotechnical lateral strength of the pile, whereas the 0.35 strength reduction factor applied by the authority's engineer is the product of the strength reduction factors applied to the structural strength of the timber pile from NZS3603.
- The pile diameter used in assessing the pile spacing ratio with B1/VM4 should be the encasement diameter of 0.6m and not the pole diameter.
- The two observation holes drilled previously by others part way up the wall show no obvious signs of drainage material. One hole drilled in the wall indicated some granular material behind the wall, while the other didn't. There was also no signs of drainage aggregate at the base of the wall, particularly at plank terminations.
- It is assumed the weep holes, installed after the expert's inspection, will relieve hydrostatic pressure. However, without effective drainage it is uncertain how successful this relief may be.

7. The first draft determination and the responses received

7.1 General

7.1.1 I circulated a first draft of this determination to the parties for comment on 18 November 2014. In the first draft I concluded that the as-built retaining wall did not comply with Clause B1 of the Building Code.

7.1.2 In reaching this decision, I accepted the conclusion of the expert that the design of the wall, as consented, did not take account of the likely earth pressure on the wall; had not used the appropriate load factor; and had not taken account of the reduction in ultimate strength due to the closely-spaced encased poles. Other factors, such as the poles that had been inserted with the small end at the bottom of the embedment, and the lack of effective drainage behind the wall, would further reduce the performance of the as-built wall. As a result, I concluded that the wall had insufficient capacity to resist lateral loads from the retained slope and did not satisfy Clause B1.3.1

7.1.3 I also considered whether the wall complied with Clause B2 Durability and Clause E1 Surface water. In both instances, I concurred with the expert's opinion and concluded that the wall did comply with regard to those Building Code clauses.

7.1.4 Having reached these decisions, I went on to consider the issuing of the code compliance certificate for the as-built retaining wall. I concluded that, as I had found that the retaining wall did not comply with Clause B1, the authority was incorrect to issue a code compliance certificate for it.

7.2 The authority

7.2.1 On 3 December 2014, the authority advised that it did not accept the first draft determination, and requested that a hearing be held about the matter.

7.2.2 On 17 December 2014, the authority commissioned a report by a firm of professional surveyors. The surveyors monitored the as-built retaining wall between August and December 2014. The resulting report concluded that: 'The results show that there has been very little movement, if any, of the wall during the 4-month survey monitoring period.' The Ministry provided a copy of the report to the parties on 14 January 2015.

7.2.3 On 23 December 2014, the authority made a submission where it set out its reasons for not agreeing with the draft determination. These were essentially that, in the authority's opinion, the as-built retaining wall did comply with Clause B1 of the Building Code. In forming this opinion, the authority relied on the advice of its technical expert ("the authority's expert") who is a specialist structural/geotechnical engineer in a major practice.

7.2.4 A statement by the authority's expert dated 23 December 2014 was attached to the authority's submission. In this statement, the authority's expert accepted that the as-built wall '…does not comply with B1 when tested using the simple analysis method presented in VM4'. The main points of the balance of the statement can be summarised as follows:

- The as-built retaining wall differs in its design from the consented retaining wall. The as-built retaining wall places 'lower demands' on the strength of the wall than the consented wall would have done.

- B1/VM4 is conservative and simplistic. Other alternative means of demonstrating compliance are available, in particular, the analysis provided by a proprietary brand of geotechnical software ("the proprietary software").
- An analysis undertaken using the proprietary software '…show the as-built wall to be compliant with B1 for all cases except where hydrostatic pressure is acting over the whole height of the wall…'. The installation of the weep holes in the retaining wall 'prevent the possibility of hydrostatic pressure being able to build up'.
- The analysis provided by the proprietary software shows that the planks used in the as-built retaining wall have 'sufficient strength' to withstand the lateral loads and are not likely to rupture because the plank ends are not located behind the posts.

7.3 The owner

7.3.1 On 10 December 2014, the owner advised that he did not accept the first draft determination.

7.3.2 On 24 December 2014, the owner, acting through the engineer who originally designed the retaining wall ("the original engineer") as his agent, made a submission. In the submission, the applicant stated that there was 'ample available information to support a conclusion that the wall does comply with B1', and summarised this information, which he stated had already been supplied to the Ministry.

7.4 The applicants

7.4.1 On 23 December 2014, the applicants made a submission in which they disagreed with the conclusions of the authority's technical expert (see paragraph 7.2.4) and signalled their intention to apply for a direction as to costs.

7.4.2 On 6 January 2015, the applicants made a further submission in which they expressed their support for the expert's first report and for the findings in the first draft determination. They also raised matters relating to certain documents created as part of the Environment Court proceedings (refer paragraph 4.2.2).

8. The hearing and post-hearing submissions

8.1 The hearing

8.1.1 I conducted a hearing in Ohakune on 12 February 2015. The hearing was attended by two of the applicants and their representatives, the authority's representatives, the owner and his representatives, the Ministry's expert, myself and other representatives of the Ministry, and a referee approved by the Chief Executive under section 187 of the Act.

8.1.2 In general, the submissions and the discussions at the hearing canvassed the points already raised in the parties' submission. The main point of difference, and the overall focus of the hearing, was a discussion between the parties and their representatives of the various design parameters and forces that needed to be taken into account in assessing the code compliance of the wall, and the correct values to be attributed to these. Also under discussion were the various methods used to analyse compliance, including B1/VM4 and those within the proprietary software used by the authority's engineers. I note that the authority also presented at the hearing a written submission dated 11 February 2015.

8.1.3 At the hearing the parties and the Ministry agreed on a process that would enable the parties, through their engineers, to come to an agreed view on the retaining wall's compliance. This involved the parties independently re-running the analysis of the wall using the proprietary software and subgrade reaction modelling, as well as recalculating it using the equilibrium methods of B1/VM4. The values for the soil and wall parameters to be used in this process were discussed and agreed at the meeting. The agreement also included an adverse groundwater load case, to account for the uncertainty around the effectiveness of the drainage behind the wall.

8.1.4 The Ministry's expert was tasked with managing this process. On 19 February 2015, the expert sent the parties an email outlining the agreed values from the meeting, and the nature of the analysis being sought from each of them.

8.2 Post-hearing submissions

8.2.1 On 16 February 2015, the owner provided additional documents relating to the construction of the retaining wall, including: soils tests; an inspection carried out by the author of the PS1; a copy of a survey plan dated 13 October 2014 showing the location of 9 retaining wall posts (at the SW end of the wall) relative to the boundary between the owner's and applicants' properties (the plan showed the posts within the owner's property by 0.28 to 0.49m).

8.2.2 On 17 February 2015, the owner provided further additional information that had been requested at the hearing. This information related to an earlier analysis of the retaining wall's compliance that had been completed by the authority's engineers using the proprietary software.

8.2.3 The applicants responded to the owner's 6 February 2015 email on 18 February 2015. The applicants referred to the survey plan saying the base of two posts encroached on their property and if all posts were surveyed it was expected 6-8 posts would also encroach. The applicants provided two diagrams showing posts with a '2.2m embedment' and a back slope of 2.5^{o} off vertical, and the position of the posts in relation to the applicants' boundary. The applicants concluded by saying they would contact the neighbour 'under separate cover to discuss the encroachment issue'.

8.2.4 The applicants responded to the expert's email of 19 February 2015 in an email and letter dated 23 February 2015. In this correspondence, the applicants set out their concerns about the hearing and the agreed analysis process that was to follow it. These concerns can be summarised as follows:

- The authority and owner, having previously relied on B1/VM1 and B1/VM4 to demonstrate compliance and (in the case of the authority) to issue the code compliance certificate, now wish to rely on an alternative solution method to show compliance.
- The design parameters were based on assumptions and the lack of quantitative information for the parameters would mean that the view would be 'at best assumptive'.
- The paucity of documents available to the authority upon which it based its initial assessments of compliance.

8.2.5 On 27 February 2015, the owner's engineers supplied the requested re-run analysis using the proprietary software and B1/VM4. Both methods of analysis showed that the as-built retaining wall complied with Clause B1 of the Building Code. Copies of this information were sent to the other experts involved in the determination.

8.2.6 On 2 March 2015, the applicants sent a further email to the Ministry, attached to which were various documents obtained from the authority. The email raised concerns with these documents, and with other matters previously discussed at the hearing. It concluded by confirming that the applicants would not be engaging their engineers 'to undertake any further assessment' on the matters discussed at the hearing, namely the agreed design parameters and their use in subsequent analysis as set out in 8.1.3 above.

8.2.7 This decision was reiterated in an email from the applicants to the Ministry dated 22 April, where the applicants confirmed that they would not be instructing their engineers to do any further work on the matter. In an email to the parties dated 7 May 2015, the applicants clarified their concerns about the design parameters discussed at the hearing.

8.2.8 In March 2015, the applicants engaged a firm of civil and structural engineers ("the structural engineers") to 'check calculations on the retaining wall planks'. The engineers provided this information in a memo dated 29 March 2015. The applicants emailed this memo to the parties on 30 March 2015, and concluded that 'the planking has now been independently assessed by a qualified engineer as being undersized whether or not there is drainage located behind the wall'. The email also made submissions on the B1/VM4 calculations, the evidence relied on by the authority in its letter of 20 March 2015, and the sufficiency of drainage fill behind the retaining wall.

8.2.9 The authority did not accept the findings in the applicants' structural engineers' report, and during early April 2015 correspondence on this issue passed between the parties, in particular focussing on the adequacy of the planking.

8.2.10 On 30 July 2015, the applicants submitted a memorandum dated 17 July 2015 from the applicants' engineers. This memorandum referred to the hearing and concluded that 'although it was agreed the wall is not going to fail catastrophically it is anticipated to perform poorly over its design life (rotation of wall, distorted lagging)…'

9. The expert's analysis and second report, and the party's responses

9.1 The analysis

9.1.1 On 19 May 2015, I commissioned the Ministry's expert to rerun the proprietary software analysis for the retaining wall using the parameters and load cases agreed at the hearing. I decided to take this course of action in the absence of a collaborative approach between the parties to do so in the manner described in paragraph 8.1.3. I advised the parties of this decision in an email dated 19 May 2015. The parties were also advised that they would be provided with the outcome of the analysis for comment, and that I had also asked the expert to comment on the parties' submissions regarding the adequacy of the planking (see paragraphs 8.2.8 and 8.2.9).

9.1.2 The expert provided the outcomes of this requested analysis on 24 June 2015. In his email attached to the analysis, the expert noted three aspects of the analysis that differed slightly from the earlier analysis run by the authority's engineers using the

same proprietary software (see paragraphs 7.2.4 and 8.2.2). He noted that these differences 'make only minor changes to the [factor of safety] for the wall, and the wall when using this analysis has sufficient strength using the agreed soil parameters and geometry'.

9.1.3 The parties were provided with a copy of the expert's email and attached analysis on 26 June 2015.

9.1.4 On 9 July 2015, in response to an internal review within the Ministry, I requested the expert to rerun the proprietary software analysis to conservatively test, using the same parameters, the wall's adhesion coefficients for timber and soil, and concrete and soil. I made this request as a sensitivity check, given the parties' concerns about the adequacy, or otherwise, of the wall's backfill. I advised the parties of this additional analysis in an email dated 9 July 2015.

9.2 The expert's second report

9.2.1 On 21 July 2015, I commissioned the expert to provide a second report. This report was to compare and the explore the differing calculations on the retaining wall's structural stability (and hence its compliance with Clause B1) obtained using the two different types of analysis: the gross pressure method and the subgrade reaction method using proprietary software analysis.

9.2.2 The expert provided a second report dated 6 December 2015. This was provided to the parties for comment on 20 January 2015.

9.2.3 In his report, the expert analysed the wall using the Gross Pressure method. The Gross Pressure method of analysis has been used in recent Ministry guidance on the seismic design of retaining structures in Canterbury.[8] The expert also ran several variations of the subgrade reaction method using proprietary software analysis to check sensitivity of the design and differing aspects of the retaining wall's performance. His findings are summarised as follows:

- The Gross Pressure method indicted that the retaining wall did not comply with the strength requirements of B1.
- The subgrade reaction method using proprietary software was run several times using the previously agreed soil strength and stiffness parameters to undertake the following analyses:
    - An analysis using the net available passive resistance method to check the overall stability of the wall.
    - A bending moment and displacement analysis of the wall. This used a subgrade-reaction analysis method, which took into account the soil–structure interaction.
    - An analysis to calculate the moments and shears in the wall, including appropriate load factors to match B1/VM4 requirements.
- These analyses showed that both the requirement for overall stability and the moments and shears in the wall complied with the requirements of Clause B1.

[8] *Supplementary Guidance: Guidance on the seismic design of retaining structures for residential sites in greater Christchurch.* (Ministry of Business, Innovation and Employment, 2014).

9.2.4 For comparative purposes, the expert re-ran the proprietary software analysis following the methodology in AS 4678[9]. Although approved for use in Australia, AS 4678 is not referenced as a means of compliance with the Building Code in New Zealand. There is at present no equivalent New Zealand standard that could be used for comparative purposes. The AS 4678 method is included as an analysis option with the proprietary software. It uses partial factors to derate the soil strength, and applies load factors to the calculated bending moments in the timber pole.

9.2.5 The AS 4678 analysis showed that, for the adverse groundwater scenario, the bending moment in the timber poles was greater than the dependable capacity of the poles, and consequently the wall would not be compliant with Clause B1 in those conditions. In all other load cases, the pole wall had sufficient capacity to resist the applied earth pressure loads. In reporting this event, the expert reported his view that current New Zealand design methodologies do not use partial factors on soil strength.

9.3 The party's submissions on the expert's second report

The authority

9.3.1 On 18 February 2016, the authority made a submission on the expert's second report, which I summarise as follows:

- The Gross Pressure method is another simplified method of calculation similar to that given in VM4. The proprietary software provides a more comprehensive analysis and shows that 'the wall has sufficient embedment'.
- The authority concurs with the expert's assessment that the elevated groundwater value of 1.1m used in the calculations is an 'extreme case and unlikely to occur (even with poor drainage behind the wall)'.
- The analysis of the bending strength of the poles shows that they have sufficient capacity 'in both the long term and extreme cases'.

9.3.2 In conclusion, the authority concurred with aspects of the expert's conclusions and stated that the analysis provided by the proprietary software was 'more rigorous', had been conducted in a manner consistent with New Zealand practice for walls, and the results produced showed that the retaining wall has 'sufficient capacity'.

The applicant

9.3.3 The applicant made a submission dated 25 February 2016on the expert's second report, summarised as follows:

- The opinions of the engineers in relation to the rerun analyses 'can only be assumptive because there is no record of the works being conducted in accordance with the consent' and no 'satisfactory standard of documentation' that the authority could rely on to determine compliance. In light of this the data used to re-run the analyses cannot be relied upon.
- The value used for the 'coefficient of earth pressure' is also assumptive. The soil factors for the location have never been tested. In addition, no evidence has been submitted or taken into account in the analyses about the 'pre-excavation stress state or spring stiffness' of the soil.

[9] AS 4678-2002: Earth-retaining structures. (Standards Australia, 2002).

- The AS4678 analysis undertaken as part of the expert's second report indicates that the retaining wall will have 'insufficient timber pole capacity' in 'extreme groundwater conditions'.
- The decisions in the first draft determination that the wall was not compliant and the authority incorrectly issued the consent and the code compliance certificate should stand.

The applicants also canvased other matters raised in previous submissions, that do not come within my jurisdiction under the Building Act.

9.4 The second draft determination

9.4.1 The draft determination was amended to take account of the expert's second report and the party's submission. A second draft of the determination was issued to the parties for comment on 23 May 2016.

9.4.2 The authority accepted the second draft without comment on 31 May 2016; the owner accepted the draft without comment on 23 June 2016.

9.4.3 The applicants responded on 7 June 2016 saying they did not accept the second draft determination. The applicants submitted (in summary):

- 'The building work was not conducted in accordance with the consent, … no as-built [drawings or] relevant producer statements…'. No evidence to support the alternative design has been provided.
- The conditions of the consent (the listed inspections) were not carried out. This has 'consequences to the integrity of the consent process'. The determination and the engagement of engineering expertise would not have been required had inspections been carried out by the authority.
- 'That the owners of 163 Miro Street are prevented from digging a shallow drain on their land is a failure to protect other property'
- 'the survey data … demonstrates that the structure encroaches on the applicant's property (at the very least there is a sub-soil encroachment)'. This is not disputed by the owner or the authority.
- 'Had the [authority] inspected the works, it would have been apparent that part of the structure encroached on other property…' 'It does not appear to be open to [the authority] … to issue a certificate for a structure partly built on neighbouring land without authorisation.'
- It is the applicants' engineer's opinion that the wall is 'already "perform[ing] poorly"' and will not meet the required minimum life of 50 years. The code compliance certificate should be reversed.

9.5 The clarification

9.5.1 Following the issue of the determination on 19 July 2016, the applicants sought a clarification under section 189 of the Act on 22 July 2016. The request for clarification in general terms was in regards to the inclusion of a statement regarding rights of support to the owner's land.

9.5.2 On 26 July 2016 I wrote to the parties with a proposal for amendments to the determination; removing a paragraph that included the statement regarding rights of support to the owner's land and amending paragraph 10.7.1 to address concerns

raised by the applicant in relation to the digging of a drain (refer paragraph 9.4.3 bullet point #3).

9.5.3 All parties responded on 1 August 2016. A legal adviser acting on behalf of the owner responded on accepting the proposed clarification, and the authority did not wish to make any submission in response to the proposed clarification. The applicants accepted the proposed clarification, noting they reserved the right to appeal the determination.

10. Discussion

10.1 General

10.1.1 The Building Code and Act require that any building must be built in such a manner as to protect 'other property' where 'other property ' is defined by the Building Code Clause A2 as:

> Other property means any land or buildings or part thereof which are –
>
> a) Not held under the same allotment; or
>
> b) Not held under the same ownership…

10.1.2 The neighbouring property is not held under the same ownership or the same allotment as the owner's property at 46 Foyle Street, I therefore consider the applicants' property is 'other property' for the purposes of the Act.

10.1.3 In relation to the 'as-built' retaining wall I note the changes made since the issuing of the code compliance certificate; being the digging and then filling of the excavation drainage trench, the extra board and the weep holes (refer paragraphs 2.12, 2.13 and 2.14 respectively). In determining whether the retaining wall complies with the Building Code I have based the following analysis on the condition of the retaining wall at the time of writing this determination, that is, with the excavation trench in front of the wall filled in and the addition of an extra board and weep holes in place.

10.2 Compliance with Clause B1 Structure

10.2.1 One of the objectives of Clause B1 of the Building Code is to protect other property from physical damage caused by structural failure. The performance requirement under Clause B1.3.2 states:

> Buildings, Building elements and sitework shall have a low probability of rupturing, becoming unstable…throughout their lives.

10.2.2 The life of a retaining wall, as defined in Cause B2.3.1 is no less than 50 years. Clause B1.3.6 also states that' sitework, where necessary shall be carried out to…avoid the likelihood of damage to other property'.

10.2.3 It has been established that 'other property' is not limited to the protection of buildings and that the land itself must also be protected from the likelihood of damage[10] and includes a real and substantial risk of damage[11].

10.2.4 I accept the opinion of the expert that the design of the wall, as it was consented, did not take account of the likely earth pressure on the wall, did not use the appropriate load factors, and did not take account of the reduction in ultimate strength due to the

[10] See also *Determination 2007/141 Requirement for a fire protection barrier to a coolstore*, Department of Building and Housing (19 December 2007)
[11] 18/6/03, Judge McElrea, DC Auckland CRN2004067301-19

closely-spaced encased poles. This original design analysis, which used a gross pressure limit equilibrium method of analysis, was fundamentally flawed and should not have concluded that the wall complied with Clause B1 of the NZBC. This is the analysis that informed the PS1 and was relied on by the authority in issuing the building consent.

10.2.5 However, the as-built wall differs from the consented wall, and what I must assess is whether the as-built wall complies with the performance requirements of Clause B1.

10.2.6 In this respect, I note that the re-analysis of the wall undertaken for the Ministry by the expert, as outlined in his second report, agrees with the owner's expert's re-analysis, as supplied on 27 February 2015. Both of these analyses indicate that the as-built wall, when analysed using the subgrade reaction method (using the proprietary software), and using load factors and soil strength reduction factors stated by the expert to be "consistent with NZ construction practice", meets the requirements of Clause B1 of the Building Code.

10.2.7 I accept the expert's opinion that the subgrade reaction method described above provides a more rigorous analysis of a structure's stability, as it takes into account the soil–structure interaction, which allows for the re-distribution of moments in the wall system, reducing the demand on the poles. It is a well-established and widely-used analysis methodology within New Zealand, and subject to appropriate selection of soil strength and stiffness parameters, it is suitable to be used as an alternative means of demonstrating compliance with Clause B1 in the current case.

10.2.8 I will turn now to the specific points raised by the applicants in their submissions on the expert's second report (see paragraph 9.3.3). The applicants have raised concerns that the reanalysis undertaken by the Ministry's expert (and the owner's expert) is based on assumptions, due to the lack of proper processes and inspections by the authority during construction. I do not accept that this is the case. The values for the soil and wall parameters used in the re-analysis were agreed by all of the engineers and other experts present at the hearing. They were based on robust discussion and drew on substantial combined expertise, including collective experience of volcanic soils, as found at the location of the retaining wall.

10.2.9 The applicants have also raised concerns about the lack of evidence relating to the 'pre-excavation stress state or spring stiffness' of the soil (refer paragraph 9.3.3). With respect to the pre-excavation stress state, I note that this is a matter that would need to be taken into account when analysing structures constructed following an excavation, such as a basement, which is not the case here. With respect to spring stiffness, I note that the stiffness values were not directly discussed at the hearing; however the stiffness values used in the analyses of both the Ministry's expert and the owner's expert are similar, and the model was tested to see if it was sensitive to changes in these values, which it wasn't. Accordingly, I am confident that the values used in the Ministry's expert's analysis are reasonable for the purposes of deciding on the retaining wall's compliance with Clause B1.

10.2.10 With respect to the applicants' concerns about the as-built planking; this was checked by the expert as part of his reporting and was found to 'have sufficient capacity for the anticipated loads when assessed in accordance with NZS 3603 Timber Design Standard'. The applicants' concerns with the planking appear to relate to the fact that some of the planks have their joints located in mid-span rather than being supported behind the poles.

10.2.11 While I agree that in normal solid timber planking this aspect might be of concern, I note that in this case the planking is formed with interlocking tongue and groove along the top and bottom edges. This feature allows the planks with their joints at mid-span to redistribute their earth pressure loads to the adjacent planks above and below which are continuous between the poles. The expert's advice is that redistribution of loads between planks in this manner was adequately allowed for in the engineer's design. I accept the expert's advice on this matter and concur that the planking complies with both the strength and durability requirements of the Building Code.

10.2.12 The final area of the applicants' concerns that I need to consider is the AS4678 methodology, which formed part of the reanalysis that the Ministry's expert undertook to inform his second report. I note that this methodology was not discussed specifically by the parties' engineers at the hearing, but rather was introduced as an analysis option already available within the proprietary software used for the other analyses. This analysis was undertaken for comparative purposes in response to queries raised internally within the Ministry.

10.2.13 The AS4678 analysis methodology uses alternative methods to account for the strength reduction in the soil parameters to achieve what are essentially characteristic strengths required by analyses of this type, which might differ from those used elsewhere in this evaluation. Given this, I am of the opinion that the results from this method of analysis should not (in this instance) be given the same weight as those from the previous subgrade reaction evaluation. The fact that it provided a different assessment of the retaining wall's compliance under the adverse groundwater conditions is not an indication that those earlier analyses are invalid.

10.2.14 I conclude that the as-built retaining wall complies with Clause B1 of the Building Code.

10.3 Compliance with Clause B2 Durability

10.3.1 Clause B2.2 states that building materials, components and construction methods shall be sufficiently durable to ensure that the building, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the building

10.3.2 It is acknowledged by the expert that the timber planking is likely to only be treated to hazard class H4 instead of the consented H5. However, B2/AS1 only requires treatment to H4 and therefore the timber planking complies with B2 of the Building Code by way of the Acceptable Solution.

10.3.3 I therefore consider the building materials and components of the retaining wall comply with Clause B2 of the Building Code.

10.4 Compliance with Clause E1 Surface Water

10.4.1 The performance requirement of E1.3.1 is to protect other property from surface water that is collected or concentrated by buildings or sitework, and dispose of it in a way that avoids the likelihood of damage or nuisance to other property.

10.4.2 The steep backfill of the retaining wall is covered with low-growing vegetation and no concentration or water from the slope above the retaining wall or the retaining wall itself was observed by the expert. In his opinion, the retaining wall and related site works do not appear to concentrate surface water. There is a vehicle access way constructed from Foyle Street to the rear lots of the owner's property that intercepts

surface water via 'well-up' sumps constructed in the access way, where surface water is collected by a kerb channel on the northwest side and a nib kerb on the southeast.

10.4.3 From the photographic evidence provided, I conclude there is not a significant amount of water discharging from the retaining wall itself. The applicants submitted that after filling in the excavation trench more surface water has been observed on their property, however, I have not seen any photographic evidence showing any significant amount of surface water concentrated by the building work and discharging onto the applicants' property. The applicant has also noted that surface water is 'evenly discharged' onto his property.

10.4.4 I agree with the assessment of the expert that the retaining wall and related site works do not appear to concentrate surface water and I therefore do not consider the construction of the wall has led to a breach of Clause E1.3.1.

10.5 Variation from the first draft determination

10.5.1 I am conscious that the decision I have reached about compliance of the retaining wall respect to Clause B1 is a reversal of the decision reached in the first draft determination: it would be helpful to explain the reasons for this change.

10.5.2 My decision is based on the more comprehensive analysis of the retaining wall's performance provided by the expert in his second report and I accept that this analysis is a valid alternative solution for demonstrating compliance in the current case. The Building Code is performance-based and it is open to the parties to use different methods than those detailed in the Acceptable Solutions and Verification Methods to demonstrate compliance.

10.5.3 In the current case, the first draft determination (and the expert's first report) relied on the gross pressure method of analysis used in B1/VM4 to assess compliance. This method showed that the retaining wall did not comply with the requirements of Clause B1. I note that the same result was reached when the expert applied B1/VM4 using the design parameters agreed at the hearing; using this methodology, the retaining wall is not shown to comply.

10.5.4 However, this does not mean that an alternative method cannot be used to demonstrate that in fact the wall does comply, especially if it can be shown that the alternative method is more comprehensive and accurate, and is suitable for use in the New Zealand context. That is the case here, and accounts for the different opinion I have now reached about the compliance of the wall.

10.6 Was the authority correct to issue a code compliance certificate for the as-built retaining wall?

10.6.1 To determine whether the authority correctly exercised its powers of decision in issuing a code compliance certificate, I must consider whether the authority believed on reasonable grounds the retaining wall complied with the building consent under section 94 of the Act. In doing so I must also consider whether the building consent was correctly issued.

10.6.2 The authority has submitted the building consent documents for the retaining wall were referred to another authority for a 'peer review' prior to issuing a code compliance certificate. I consider an appropriate peer review to be one carried out by a person of similar qualifications and experience to the author of the PS1. No peer review of the wall's design was carried out at consent stage; the review carried out by the other authority before the code compliance was issued appears to have been

an audit of the authority's regulatory process. The authority has referred to a PS2 Design Review completed in May 2013 that has not been provided to me. I observe that a PS2 Design Review is normally undertaken before the issue of a building consent.

10.6.3 The authority's building consultant has concluded in his written submissions that the authority relied solely on the PS1 in issuing the building consent. I agree with the observations of the expert in paragraph 6.4.1 (2nd bullet point) that there are circumstances where it is not reasonable to do so. I do not consider that the authority's apparent sole reliance on the PS1 in the current case constitutes 'reasonable grounds' and something more was required from the authority in terms of assessment of compliance.

10.6.4 Under section 94(1)(a) of the Act, an authority must issue a code compliance certificate if it is satisfied, on reasonable grounds, that the building work complies with the building consent including any amendments made to that consent.

10.6.5 The expert noted a number of variations between the consented works and the as-built retaining wall during the site inspection. These differences include a change in the backfill slope above the retaining wall. Although I agree with the expert that this variation reduces the lateral earth pressures on the retaining wall, it still constitutes a variation to the building consent documents. The other variations include significant changes to the configuration of the wall (in plan and elevation), drainage metal not found consistently behind the wall planking, and the natural ground sloping away from the toe of the wall at 10º-15º from horizontal.

10.6.6 Given the differences in the as-built work from the approved plans, it is my opinion that the compliance of the building work required evaluation before consideration was given to the issuing of a code compliance certificate. In addition, as I have come to the view that the reasonable grounds test was not met in issuing the building consent, the reliance on the consent documentation in issuing the code compliance certificate was also flawed.

10.6.7 While my findings are that the as-built retaining wall complies with the Building Code and the code compliance certificate could be issued on that basis, I do not consider the authority correctly exercised it powers in making its decision.

10.7 The protection of other property

10.7.1 The applicants' contend that their inability to dig a drain on their property in front of the wall means the wall is failing to protect the applicants' property. I note that there are specific clauses of the Building Code that relate to the protection of other property; in this case the relevant clauses being B1.3.1 in respect of clause B1.1(c), and Clause E1.3.1 which concerns the disposal of surface water. I have concluded that the retaining wall complies with Clause B1 and E1 (refer paragraphs 10.2.14 and 10.4.4).

10.8 The possible encroachment of the wall on the applicants' property

10.8.1 The applicants maintain that the concrete embedment to some retaining wall posts is encroaching on their land and that the authority was not able to issue a code compliance certificate because of this. The evidence that the wall encroaches on the applicants' property is not clear.

10.8.2 The applicants' diagrams (refer paragraph 8.2.3) assumes a uniform post embedment of 2.2 m with a back slope of 2.5º off vertical. The survey data (refer paragraph

8.2.1) shows the base of the 9 posts measured at between 0.28 to 0.490m from the applicants' boundary (the wall has a total of about 33 posts).

10.8.3 The embedment depths of the posts are at their shallowest at either end of the wall to correspond with the wall's lower height at either end. The expert says the wall's back slope varies from 3.4º to 0.3º off vertical.

10.8.4 In my view the variation in back slope and post depth means that any encroachment of the retaining wall structure onto the applicants' property can only be determined once the location of every post, and its embedment, is known (distance from boundary, embedment depth, and back slope).

10.8.5 I consider the possible encroachment issue is outside the matters can I determine under the Act. I also note that the applicants have advised they will contact the owner to resolve any possible encroachment issue.

11. The decision

11.1 In accordance with section 188 of the Building Act 2004, I hereby determine that:

- the as-built retaining wall complies with Clause B1 and Clause E1 of the Building Code, and the component parts of the wall comply with Clause B2
- while I consider the authority incorrectly exercised its powers in issuing the code compliance certificate for the retaining wall at the time this decision was made, I confirm the decision to issue the compliance certificate on the grounds that the building work complies with the Building Code.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 3 August 2016.

John Gardiner
Manager Determinations and Assurance

Appendix A: The legislation

A.1 The relevant clauses of the Act include:

94 Matters for consideration by building consent authority in deciding issue of code compliance certificate

(1) A building consent authority must issue a code compliance certificate if it is satisfied on reasonable grounds, —

(a) that the building work complies with the building consent

A.2 The relevant clauses of the Building Code include:

Clause A2 – Interpretation

Sitework means work on a building site, including earthworks, preparatory to or associated with the construction, alteration, demolition, or removal of a building

Clause B1 - Structure

Objective

B1.1 The objective of this provision is to:

(a) safeguard people from injury caused by structural failure,

(b) safeguard people from loss of amenity caused by structural behaviour, and

(c) protect other property from physical damage caused by structural failure.

Functional requirement

B1.2 Buildings, building elements and sitework shall withstand the combination of loads that they are likely to experience during construction or alteration and throughout their lives.

Performance

B1.3.1 Buildings, building elements and sitework shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives.

B1.3.2 Buildings, building elements and sitework shall have a low probability of causing loss of amenity through undue deformation, vibratory response, degradation, or other physical characteristics throughout their lives, or during construction or alteration when the building is in use.

B1.3.3 Account shall be taken of all physical conditions likely to affect the stability of buildings, building elements and sitework, including:

(a) self-weight,

(b) …

(d) earth pressure,

(e) water and other liquids,

(l) reversing or fluctuating effects,

(m) differential movements,

(q) time dependent effects including creep and shrinkage, and

(r) removal of support

B1.3.6 Sitework, where necessary, shall be carried out to:

(a) Provide stability for construction on the site, and

(b) Avoid the likelihood of damage to other property.

B1.3.7 Any sitework and associated supports shall take account of the effects of:

…

(c) Ground loss and slumping.

Clause B2—Durability

Objective

B2.1 The objective of this provision is to ensure that a building will throughout its life continue to satisfy the other objectives of this code

Functional requirement

B2.2 Building materials, components and construction methods shall be sufficiently durable to ensure that the building, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the building.

Performance

B2.3.1 Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:

(a) the life of the building, being not less than 50 years, if:

(i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or

(ii) those building elements are difficult to access or replace, or

(iii) failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.

(b) 15 years if:

(i) those building elements (including the building envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or

(ii) failure of those building elements to comply with the building code would go undetected during normal use of the building, but would be easily detected during normal maintenance.

(c) 5 years if:

(i) the building elements (including services, linings, renewable protective coatings, and fixtures) are easy to access and replace, and

(ii) failure of those building elements to comply with the building code would be easily detected during normal use of the building.

B2.3.2 Individual building elements which are components of a building system and are difficult to access or replace must either:

(a) all have the same durability, or

(b) be installed in a manner that permits the replacement of building elements of lesser durability without removing building elements that have greater durability and are not specifically designed for removal and replacement.

Clause E1—Surface water

Objective

E1.1 The objective of this provision is to:

(a) safeguard people from injury or illness, and other property from damage, caused by surface water, and

(b) protect the outfalls of drainage systems.

Functional requirement

E1.2 Buildings and sitework shall be constructed in a way that protects people and other property from the adverse effects of surface water.

Performance

E1.3.1 Except as otherwise required under the Resource Management Act 1991 for the protection of other property, surface water, resulting from an event having a 10% probability of occurring annually and which is collected or concentrated by buildings or sitework, shall be disposed of in a way that avoids the likelihood of damage or nuisance to other property