

**IN THE MATTER OF**

of the Resource Management Act 1991

**AND**

**IN THE MATTER OF**

of Resource Consents and Notices of Requirement for the Central Interceptor main project works under the Auckland Council District Plan (Auckland City Isthmus and Manukau Sections), the Auckland Council Regional Plans: Air, Land and Water; Sediment Control; and Coastal, and the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

**STATEMENT OF EVIDENCE IN REPLY OF  
JOHN QUENTIN COOPER ON BEHALF OF WATERCARE SERVICES  
LIMITED**

**PROJECT CONSTRUCTION**

**1. INTRODUCTION**

**Qualifications and experience**

1.1 My name is John Quentin Cooper. My qualifications and experience are set out in my primary statement of evidence.

1.2 I confirm that I have reviewed, and agree to comply with, the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note (2011).

**Scope of this reply evidence**

1.3 The purpose of this reply evidence is to respond to concerns expressed by Foodstuffs (Auckland) Limited ("**Foodstuffs**") and St Lukes Garden Apartments/St Lukes Garden Apartments Progressive Society Incorporated at the hearing about potential settlement or deformation of their buildings. I will provide comment on the work undertaken to date, the intended construction methodology, and the ability and willingness to

monitor sensitive buildings. I will also respond to the concerns expressed regarding the potential flooding of Foodstuffs' land, and explain a number of amendments to the consent conditions proposed in the Reply Set.

- 1.4 I have discussed the groundwater and settlement issues with Mr Twose during the preparation of this brief and confirm that he has had input into this brief.

## **2. SETTLEMENT**

### **Foodstuffs**

- 2.1 Mr Mullaly, on behalf of Foodstuffs, raised concerns about further settlement of the Foodstuffs' warehouse floors, which are ground bearing slabs between piled piers, due to the construction and continued presence of the proposed May Road shaft. Differential settlement between floor slabs and between slabs and the structure of the building has already occurred over a number of years.
- 2.2 Mr Mullaly also noted the presence of compressible materials at the May Road site and beneath the adjacent Foodstuffs buildings. He was concerned that the construction and operation of the shaft at the May Road site will result in dewatering of the compressible materials and settlement of Foodstuffs' buildings if the shaft is "not sealed on construction and retained in a sealed state thereafter".<sup>1</sup>
- 2.3 Mr Mullaly also highlighted the presence of relatively porous basalt beneath the site that "will provide free drainage into the shaft for water currently contained in the basalt or in the overlying compressible soils".<sup>2</sup>
- 2.4 I concur with Mr Mullaly's comments and recognise that the design and age of the Foodstuffs' warehouse make it sensitive to further ground settlement. I also accept that the design and construction of the temporary and permanent works at the May Road site (including the shaft and main tunnel) must take proper account of this. This is entirely consistent with the findings presented in the Groundwater and Surface Settlement Report

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<sup>1</sup> Evidence of Mr Mullaly at paragraph 11.

<sup>2</sup> Evidence of Mr Mullaly at paragraph 11(a).

prepared by Mr Twose ("**Report**") attached to the August 2012 Assessment of Environmental Effects.<sup>3</sup>

(a) Section 9.2 (page 42, paragraph 2) of the Report states:

At shaft sites WS1, WS2, and AS7 very high flows would be expected if they were excavated unlined (particularly through the surface basalt material). Shafts at these sites will necessarily require lining...

(b) Section 10.3 (page 45, paragraph 1) states that:

Analyses indicate...the potential for relatively large settlement to develop rapidly when:

...

- A shaft is excavated in ECBF overlain by Puketoka Formation (WS2, AS3, AS4, and AS7).

In these areas, where shafts are in the vicinity (within approximately 200–300m) of settlement sensitive structures, construction methodologies that allow control of groundwater effects are likely to be required. With appropriate design, one of the construction methodologies discussed in Section 2.3.2, or a combination of such methods.....can be expected to provide the level of control on groundwater effects required.

(c) Section 2.3.2 (page 6, paragraph 1) identifies that:

Construction methodology employed will depend on specific site conditions. In locations where the ground is sensitive to groundwater drawdown effects, methodologies such as those employing the following techniques are likely to be required to manage draw down to acceptable levels (less than "minor effect") in surrounding geology.

- Secant piles,
- Diaphragm walls
- Open caisson
- Grouting.

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<sup>3</sup> Technical Report J, referred to in proposed Consent Condition 1.1(d) and proposed Designation Condition DC.1(d).

2.5 I agree with Mr Mullaly that the key ground settlement related issues on this site are:

- (a) the watertightness of the temporary and permanent works;
- (b) the presence of highly permeable basalt;
- (c) the presence of soils with potential for consolidation settlement due to stress (groundwater) changes; and
- (d) the high existing water table with rapid recharge.

2.6 The design, age and settlement history of the warehouse structures also makes them more sensitive.

2.7 However, I do not agree that blasting will increase the basalt's permeability. Controlled blasting techniques can limit the "damage" to the basalt rock mass to very short distances from the shaft, eg by the use of pre-splitting techniques (**Figure 1** below).



**Figure 1: Example of controlled blasting rock face.**

2.8 As with all projects of this type, the geology and hydrogeology will be investigated further during detailed design and an appropriate construction methodology developed.

2.9 Once the tunnelling works are complete, the permanent internal structure of the shaft will be installed using an in situ concrete lining, making the shaft substantially watertight for the long term. The surrounding backfill

that is placed between the outer temporary structure and the permanent structure would be compacted to the required engineering standard. In the case of multiple groundwater tables and where vertical connection represents a risk, low strength concrete (flowable fill) can be used.

2.10 In addition to the methods expressly discussed by Mr Twose in his Report and referenced above, additional options are available to the designers such as:

- (a) recharging through wells outside the works; and
- (b) use of segmentally lined shafts (see **Figure 2** below).



**Figure 2: Example of segmental lining for shaft sinking (perco.co.uk).**

2.11 As noted above, Mr Mullaly was concerned that construction and operation of the shaft at the May Road site will result in dewatering of the compressible materials and settlement of Foodstuffs' buildings if the shaft is "not sealed on construction and retained in a sealed state thereafter". As I have explained, Watercare is well aware of the issues that Mr Mullaly has raised and there are construction options available to the selected contractor to manage drawdown to acceptable levels.

2.12 I discuss the Reply Set of the proposed Consent Conditions in a later section of this reply evidence. At this point, however, I wish to note that the new Consent Condition 4.12 will enable landowners, such as Foodstuffs, with sensitive buildings to request pre-construction surveys and monitoring. I anticipate that Foodstuffs will make such a request and also

understand that Watercare has already offered to include a number of Foodstuffs' buildings (including its warehouse) in this pre-construction condition assessment programme in order to provide that certainty now.

**St Lukes Garden Apartments/St Lukes Garden Apartments Progressive Society Incorporated**

- 2.13 Mr Shorten's evidence for St Lukes Garden Apartments and St Lukes Garden Apartments Progressive Society Incorporated (together "**St Lukes Garden Apartments**") discusses the ground settlement and vibration effects at the Lyon Avenue proposed shaft site. His evidence includes a "Background" section which is a reasonable description of the situation. In particular, Mr Shorten draws attention to the importance of differential settlement for the St Lukes Garden Apartments.
- 2.14 The work done by Tonkin & Taylor is an initial assessment of likely settlement which is sufficient to demonstrate feasibility of the Project and inform the concept design, resource consent and notice of requirement process. This initial assessment was never intended as a comprehensive assessment of this site and the risk to buildings.
- 2.15 In paragraph 24 of his evidence, Mr Shorten describes Apartment Block B/27 as a "potentially sensitive structure". While I am not yet in a position to decide whether it is particularly sensitive, I accept that the design and construction of the temporary and permanent works for the Lyon Avenue shafts and the main tunnel must take proper account of ground conditions, groundwater and the nature of the buildings nearby. This is described and acknowledged in the Report by Mr Twose referred to in paragraph 2.4 above.
- 2.16 Watercare's proposed Conditions provide for a systematic risk assessment during detailed design and the development of appropriate design and construction methods to manage the settlement risks.
- 2.17 The reference above at paragraph 2.4(c) to section 2.3.2 of Mr Twose's Report, and my paragraphs 2.9 and 2.10 above in respect of the May Road site, are equally relevant to the Lyon Avenue site. Similarly to Foodstuffs, St Lukes Garden Apartments can request that Apartment Block B/27 be included in the pre-construction condition survey programme (as a result of new Consent Condition 4.12), regardless of whether it is identified as "at risk" in the initial assessment.

### 3. PROPOSED CONSENT CONDITIONS

- 3.1 A number of queries were raised during the hearing about the construction conditions. I provide comment below.

#### **Consent Condition 4.12**

- 3.2 Consent Condition 4.12 was originally proposed in the Pre-hearing Report but was opposed by Watercare and is not shown in the Hearing Set. The condition is designed to ensure that particularly sensitive structures receive a sufficient level of condition assessment. Watercare now agrees with the Council that it would be beneficial to include a mechanism where landowners can establish the presence of buildings or structures that are particularly sensitive to changes in groundwater and ground settlement. It would, however, be excessive to give potentially large numbers of property owners the right under the condition to require a full engineering assessment at their discretion, as originally proposed by the Council. I believe that would set a precedent that allows an unmanageable and open-ended obligation on Watercare. The wording that the Council had suggested for proposed Consent Condition 4.12 has therefore been modified and, in the Reply Set, reads:

*Where owners of neighbouring buildings or properties establish the presence of buildings or structures (including vibration sensitive equipment, structures subject to unusually heavy loads, or settlement sensitive machinery) that are particularly sensitive to any groundwater and ground settlement changes, the Consent Holder shall, unless otherwise agreed with the Manager not to be required, undertake a detailed pre-construction condition survey of these structures in accordance with Condition 4.11, to confirm the existing condition and to enable the sensitivity of the existing buildings and structures to any groundwater and ground settlement changes to be accurately determined. If this survey identifies that the building or structure is at risk of damage due to groundwater and ground settlement changes expected from pre-construction assessments, then the Consent Holder shall identify any additional site specific settlement or building deformation monitoring required and shall develop details of the specific contingency measures to be implemented in the event of trigger levels being exceeded, including details on the practicable methodologies to avoid, remedy, or mitigate surface settlements with the potential to cause damage to the building or structure. These monitoring and contingency measures shall be described in the M&CP required under Condition 4.5.*

3.3 I support this wording.

#### **Consent Condition 4.30**

3.4 Mr Twose and I have reviewed the proposed Consent Condition 4.30 which is intended to manage the response to movement identified by Building Movement Monitoring Marks, through the use of trigger values. Watercare now propose to define Alert Level and Alarm Level as follows:

*'Alert Level' –is the Differential and Total Settlement Limit set at a threshold less than the Alarm Level, at which the Consent Holder shall implement further investigations and analyses as described in the M&CP to determine the cause of settlement and the likelihood of further settlement.*

*'Alarm Level' - is the Differential and Total Settlement Limit set in Condition 4.33, or which has the potential to cause damage to buildings, structures and services, at which the Consent Holder shall immediately stop dewatering the site and cease any activity which has the potential to cause deformation to any building or structure or adopt the alternative contingency measures approved by the Manager.*

3.5 Watercare provided these new definitions to the Council on Wednesday 7 August 2013. The Council proposed a small number of amendments, shown in underline above, which Watercare has agreed to incorporate to further clarify the purpose of the Consent Conditions to follow.

3.6 I consider this removes the uncertainty and ambiguity existing in the Hearing Set version of the condition. The references to Alert and Alarm Levels have also been re-ordered to reflect that the Alert Level will be reached before the Alarm Level. This further reduces any confusion that may have been caused by the earlier drafting.

#### **Consent Condition 6.3(fa)**

3.7 Mr Mullaly raised concerns about potential effects on flood plains and overland flow paths which could be adversely affected by Watercare's proposed works with potential off-site effects on Foodstuffs' site.<sup>4</sup>

3.8 The issue of flooding at this site is already known.<sup>5</sup> I have consulted further with AECOM's flood hazard team and been advised that:

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<sup>4</sup> Evidence of Mr Mullaly at paragraphs 18 to 23.

<sup>5</sup> Refer Part A of the Assessment of Effects on the Environment at 12.16, page 127 and Part B at 6.5.12, page 99.

- (a) the construction of the Foodstuffs' facilities in the 1960s modified the natural overland flow paths in this area. As a result, the low lying Watercare site currently acts as a natural stormwater detention pond, which to some extent alleviates flooding on the Foodstuffs' site;
- (b) parts of both the Foodstuffs and Watercare sites are located in a predicted food plain and have a history of flooding as described by Mr Mullaly;
- (c) the May Road site will need to be re-profiled (lifted) to form a working platform for construction activities and to protect the permanent works afterwards from flooding;
- (d) stormwater reaching the May Road site at present can currently discharge via the existing 1800mm stormwater pipe under Foodstuffs' property or via an existing overland flow path to the west of Foodstuffs' property as shown on Mr Mullaly's Attachment 5;
- (e) the temporary and permanent land form on the May Road site will need to be designed to protect Watercare's works, avoid adverse impacts on adjacent properties, and to take account of the changes to the local system as a result of the completion of SH20; and
- (f) a number of possible solutions are available to achieve this, such as adding detention ponds on the May Road site, extending the existing 1800mm stormwater pipe, or modifying the existing secondary overland flow path.

3.9 This issue will be addressed through the detailed design phase. I understand that Watercare intends to consult with Foodstuffs and its advisors on the proposed solution and its design.

3.10 In any event, proposed Consent Conditions 6.2 - 6.4 expressly address the risk of adverse effects from flooding. I have discussed these conditions with AECOM's flood hazard team and understand these are conditions that could be expected to be applied to, and policed for, any developer of this site.

- 3.11 Nonetheless, Watercare has suggested a further amendment to proposed Consent Condition 6.3 to extend the scope of the Stormwater Management Plan to reassure Foodstuffs, and adjacent owners at other sites in identified flood hazard areas, that any potential effects of Watercare's works on flood plains and overland flow paths will be considered and addressed. The Reply Set requires:

*6.3 The Stormwater Management Plan(s) shall include, but not be limited to:*

...

*(fa) An assessment of the potential effects of site development on existing overland flow paths and the proposed measures to ensure adjacent properties are not adversely affected by the Consent Holders' construction or permanent works;*

- 3.12 In my opinion, this proposed condition will ensure that any potential effects are identified and sufficiently mitigated.
- 3.13 Council staff provided a set of conditions on Friday 9 August which included, under Section 6 Stormwater – Permanent Works, modifications to proposed Consent Condition 6.3 dealing with Stormwater Management Plan(s). Council required a description in Consent Condition 6.3(c) of how "100 year ARI attenuation to pre-development levels" will be met for May Road, increased from 2 and 10 year ARI's proposed in the Pre-hearing Report. The Council has not yet provided any technical information or even reasoning to support this proposed change.
- 3.14 I am concerned that this condition could be interpreted as requiring Watercare to maintain the current detention capacity of the undeveloped site, or to provide adequate detention for a 100 year ARI event. There is insufficient land within the designated site to provide this level of attenuation storage and Watercare could not comply with this condition.
- 3.15 A possible alternative interpretation is that the condition would require Watercare to provide adequate detention for the stormwater directly from impervious areas within the designated site during a 100 year ARI event. If this is the intent, there may be sufficient land within the designated site.
- 3.16 In the absence of any reasoning or justification from the Council staff, I do not support the proposed amendments to the table in proposed Consent Condition 6.3(c).

#### **4. CONCLUSION**

4.1 I agree that there is a risk of settlement from the proposed works at both the May Road and Lyon Avenue sites from uncontrolled shaft sinking. The proposed process for managing this risk and the proposed conditions will allow for proper protection of the buildings. Construction and permanent works methods are available to prevent settlement caused by:

- (a) elastic deformation of the ground (mechanical settlement); and
- (b) lowering of groundwater.

4.2 Additional investigations and site specific assessments of the potential settlement effects will be undertaken at these sites during detailed design, and this will be used to inform the development of the design and construction methodologies necessary to protect the existing buildings and structures. This is normal practice for projects of this type including Project Hobson and the Rosedale Project.

4.3 I understand that Watercare has already contacted Foodstuffs with an offer to include certain buildings in the pre-construction condition survey programme, and I anticipate it will shortly do the same with Apartment Block B/27. With the inclusion of new Consent Condition 4.12 in the Reply Set there is no need for the conditions to specifically list properties or buildings to be included in the pre-construction condition survey programme.

4.4 I therefore conclude that the process of risk assessment and management of settlement, including that from groundwater, that has been proposed by Watercare remains appropriate for May Road and Lyon Avenue sites and will be effectively controlled by the relevant proposed Consent Conditions.

**John Quentin Cooper**

**13 August 2013**