BEFORE THE DECISION MAKERS APPOINTED BY THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER OF The Resource Mangement Act 1991 ("RMA")

AND

IN THE MATTER OF Resource consent application RMA 2019 373, CRC193563, CRC193564 and CRC193773 by SOL Quarries for a consent to discharge contaminants from cleanfilling onto and into land where they may enter water

STATEMENT OF EVIDENCE OF PETER FRANCIS CALLANDER ON BEHALF OF SOL QUARRIES LIMITED

GROUNDWATER QUALITY

INTRODUCTION

Qualifications and Experience

1. My name is Peter Francis Callander. I hold the qualifications of BSc (Geology) from the University of Auckland and MSc (Earth Sciences) from the University of Waterloo (Canada). I am a member of the New Zealand Hydrological Society, Water NZ and the USA based National Ground Water Association.
2. Since 1991, I have been employed by Pattle Delamore Partners Limited, an environmental consulting firm specialising in ground and water resources. In 1997, I was appointed as a Director of that firm. My current employment role is as Technical Director – Water Resources.
3. Previously I had been employed for eight years by the Canterbury Regional Council and its predecessor the North Canterbury Catchment Board. During this time, I was involved with the Regional Council's groundwater resource investigations and field trials. Between 1989 and 1991, I was in charge of that Council's groundwater section.
4. I have been involved with the assessment of groundwater flow and aquifer management in alluvial gravel aquifers for a large part of my career. This has involved work for Regional Councils (including the Canterbury Regional

Council) in their regulatory capacity and for clients carrying out land use activities that impact on the groundwater resource.

5. I have previously been involved in work related to assessment of groundwater contamination risks and other groundwater issues arising from other quarries, landfills, residential subdivisions in western Christchurch and irrigation schemes across the Canterbury Plains and have appeared before the Environment Court as an expert witness many times, including at hearings regarding the Kate Valley landfill, Christchurch Airport stormwater discharge via ground soakage, Wairau Valley Hydro-Electric Power Scheme, quarry extensions and new quarry developments at Yaldhurst and Burnham and groundwater allocation and management issues for irrigation consent applications and regional plan hearings.
6. I have been engaged by SOL Quarries Ltd to provide advice on the likely groundwater quality effects arising from their deposition of cleanfill compared to effects on groundwater quality that have been observed at the Miners Rd quarries, located around 4 km to the south-west.

Code of Conduct

7. I have read and am familiar with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2014, and agree to comply with it. My qualifications as an expert are set out above. Other than where I state that I am relying on the advice of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

8. I have prepared this short statement of evidence to provide an indication of the likely impact of the proposed deposition of cleanfill at SOL Quarry on the underlying groundwater quality. In particular I want to correct the impression given in the S42A Officer's Report that the impacts may be similar to what is observed at the Miners Road quarries. This is specifically referenced in paragraph 264 of the s42A report, which is based on the groundwater information in Appendix 2 of that report, specifically paragraphs 43 and 56 – 62.

WATER HARDNESS

9. The key water quality impact identified in the s42A report that has concentrations approaching limits specified in the Drinking-water Standards for New Zealand 2005 (revised 2018) (DWSNZ) is water hardness, which is calculated from the concentrations of calcium and magnesium dissolved in the groundwater. The DWSNZ does not specify any adverse health effects for hardness, but it does indicate the following Guideline Values related to aesthetic effects (based on total hardness (Ca + Mg) as $CaCO_3$):
    a. Less than 100 mg/L the water may be corrosive. In the area west of Christchurch, natural groundwater quality has low hardness and this sometimes causes problems with the failure of heating coils in hot water cylinders and elevated metals in drinking-water, derived from tap fittings.
    b. Within the range of 100 – 300 mg/L people may experience a hard water taste (at the higher end of this concentration range the water may have a chemical taste, or taste like chalk).
    c. Above 200 mg/L scale deposition and scum formation may occur.

10. Background hardness concentrations in the SOL Quarry area are around 40 – 60 mg/L. So, a small increase in hardness does not represent an adverse effect, although if concentrations increased above 100 mg/L in drinking-water supply wells they would be in the range where taste effects might start to occur. If concentrations exceeded 200 mg/l then water in sinks, baths and washing machines may start to form a scale or scum.

GROUNDWATER EFFECTS FROM CLEANFILL ON HARDNESS

11. Groundwater monitoring adjacent to some of the quarries at Miners Rd have shown water hardness concentrations above 100 mg/L, which is within the range where taste effects may occur. The Council Officers have used this example to suggest that similar effects could occur from the SOL Quarry.
12. In my opinion the effects on groundwater quality from the deposition of cleanfill, as proposed by SOL Quarry, will be less than the effects observed at Miners Rd, that have been described in the s42A report, for the following reasons.
    12.1. The Miners Road quarries occupy a much larger area (around 180 ha) compared to the SOL Quarry (around 30 ha).

12.2. Quarries in the Miners Road area have been operating since the 1950's and prior to the 1980's there were few controls on the depth of excavation and the type of fill that was placed into the quarries. In more recent years, tighter controls have been placed on both excavation depth and on the backfill materials, however some consents still allowed the disposal of concrete slurry. That is likely to be the main factor causing the elevated hardness values that have reached concentrations of around 100 mg/L detected in some groundwater monitoring bores close to the Miners Road quarries. Concrete slurry will not be discharged at SOL Quarry.

12.3. The groundwater in this area is recharged not only from infiltrating rainfall, but also from seepage losses from the Waimakariri River. This river recharge has very low concentrations of dissolved chemicals. As a result, there is a general trend of low concentrations in groundwater close to the river and increasing concentration with increasing distance south-westwards from the river. This occurs because as the distance from the Waimakariri River increases to the south-west, the groundwater receives a greater proportion of recharge from land-use activities relative to the amount of seepage recharge losses from the Waimakariri River. This is shown by the general pattern of groundwater hardness values presented in Figure 1 attached to my evidence, which was prepared for a groundwater quality assessment in 2013. Groundwater flows in a general south-easterly direction (perpendicular to the groundwater level piezometric contours shown in Figure 1) and SOL Quarry occurs in an area of lower background hardness concentrations (40 – 60 mg/L), compared to the higher hardness concentrations upgradient (to the north-west) of the Miners Road quarry area (i.e. 60 – 80 mg/L). Figure 2 shows a similar groundwater quality pattern from a more recent ECan report, using electrical conductivity measurements, which provide a general indication of the total dissolved chemicals in the groundwater.

13. This very good groundwater quality in the area is demonstrated by three groundwater monitoring bores at SOL Quarry: BX23/0035 and BX23/0036 (located upgradient and downgradient of some historic fill activities) and BX23/0037 (located downgradient of current cleanfill activities). I have been

provided with five recent monitoring results from these bores that show the hardness monitoring values listed in Table 1.

Table 1. Hardness Concentrations from three monitoring bores at SOL Quarry

Sampling Date	Monitoring Bore		
	BX23/0035	BX23/0036	BX23/0037
27 November 2018	47	48	47
10 January 2019	48	48	48
10 March 2020	46	47	48
14 September 2020	49	48	47
3 November 2020	49	50	48

14. These values show no adverse effects on groundwater quality arising from the current SOL Quarry and cleanfill activities.

GENERAL EFFECTS ON GROUNDWATER QUALITY

15. My understanding of the SOL Quarry cleanfill proposal is to utilize the fill definition adopted for the recent Roydon Quarry consent, but with a more practical judgement and monitoring of the clean fill material, as described in the evidence of Mr Hedley (consent numbers CRC192408 and CRC192409).
16. In my opinion, the deposition of this material may cause some changes in groundwater quality and there could be some increases in the hardness of the groundwater, but I would not expect it to be of such a magnitude that there would be adverse effects at the downgradient drinking-water supply bores. In that regard, my expectation is for a slightly lesser level of effect that is described in paragraph 61 of ECan's groundwater scientist Ms Amber Krelegers report in Appendix 2 of the s42A report. I think the reason for our differing views is because she is expecting effects similar to the Miners Road quarries, but as described in paragraph 12 of this statement, the effects should be less.

17. It then follows that in terms of any wider scale effects I agree with Ms Krelegers conclusion where she says at paragraph 71 (Appendix 2 of the s42A report):

> *Given that any effects on groundwater quality are expected to be localised to near the quarry site, the risks posed by aesthetic properties to groundwater quality in and users of the public wells for CIAL and CCC is low. It is highly unlikely that contaminants from the proposed sites would be transported over these distances at high enough concentrations to cause any problems.*

18. To provide certainty about the effects on groundwater quality for downgradient users I generally agree with the monitoring approach set out in paragraphs 87 – 91 of Ms Krelegers report, with the following adjustments:
    - 18.1. The conductivity trigger in Table 1 should be specified as 50 mS/m
    - 18.2. The bacterial monitoring criteria in Table 1 should be based on Escherichia coli (as specified in the current DWSNZ) and not Faecal coliform bacteria, which comes from a previous version of the DWSNZ.
    - 18.3. The requirement for off-site sampling in condition a(iii)(c) and a(iii)(d) should only take place after a careful evaluation of the monitoring data and consultation with ECan to ensure that further sampling is the appropriate response to the exceedance of the Table 1 trigger levels. Also, any off-site sampling should only occur at drinking-water supply wells, as those are the only wells which could potentially experience an adverse effect.

CONCLUSION

19. The proposed deposition of cleanfill at SOL Quarry has the potential to cause a small, localised change in groundwater quality. The parameter with the greatest potential to impact on drinking-water quality is water hardness, which can, at elevated concentrations, cause aesthetic effects related to the taste of the water and the potential for formation of scale and scum.
20. The effects from this proposal are likely to be less than what has been observed at the Miners Road quarries because it occurs at a smaller quarry, with stricter controls on excavation depths and allowable cleanfill and is located in an area that has lower background hardness values.
21. As a result, it is not expected that downgradient drinking-water wells will experience any adverse effect. To fully address the concerns raised by neighbouring bore owners and the ECan officers, it will be prudent to require

groundwater monitoring and mitigation conditions, similar to those that are currently proposed.

Peter Callander

20 November 2020

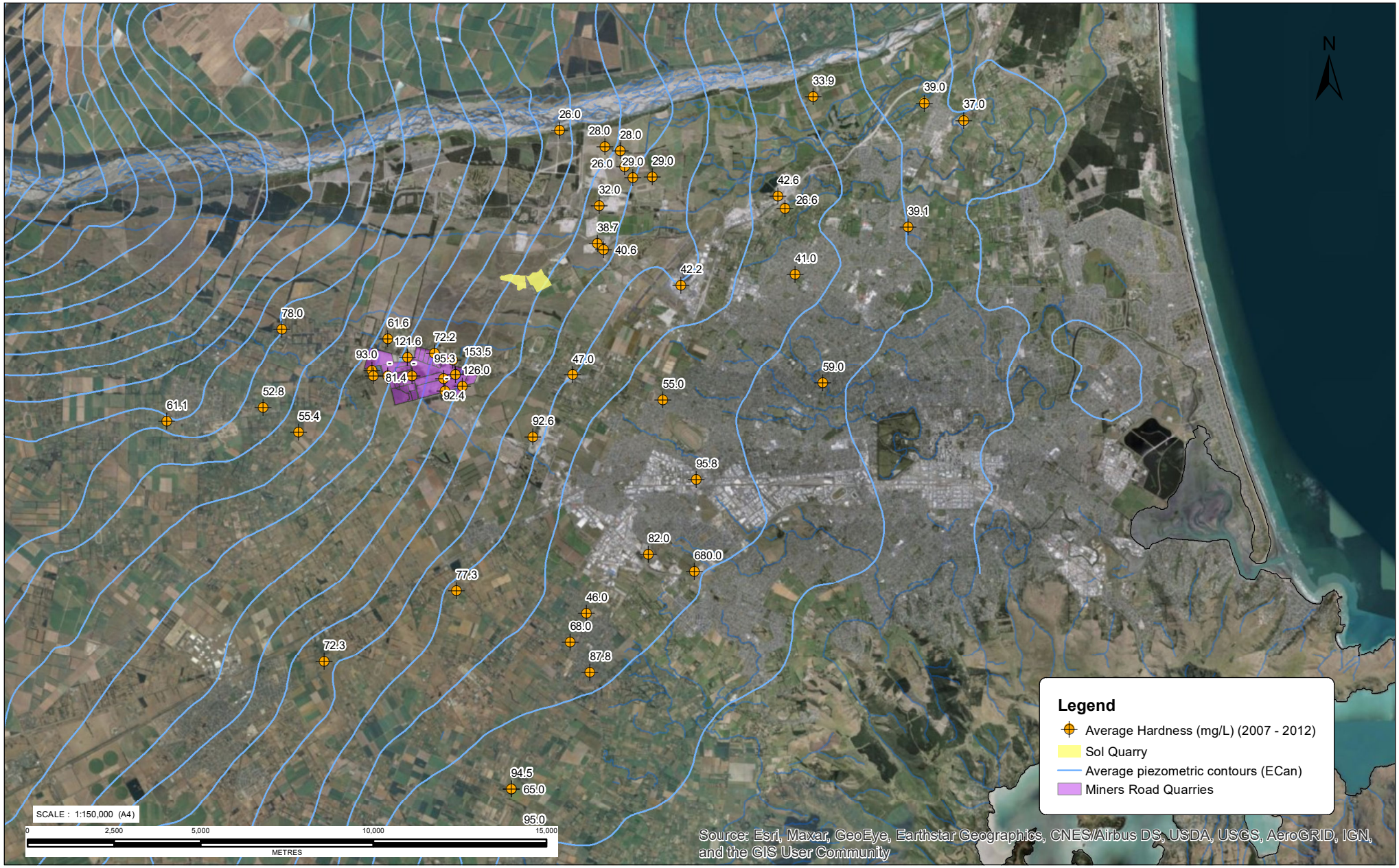

Figure 1: Hardness for wells less than 40 m deep for wider west Christchurch area based on data from ECans online GIS system and individual quarries

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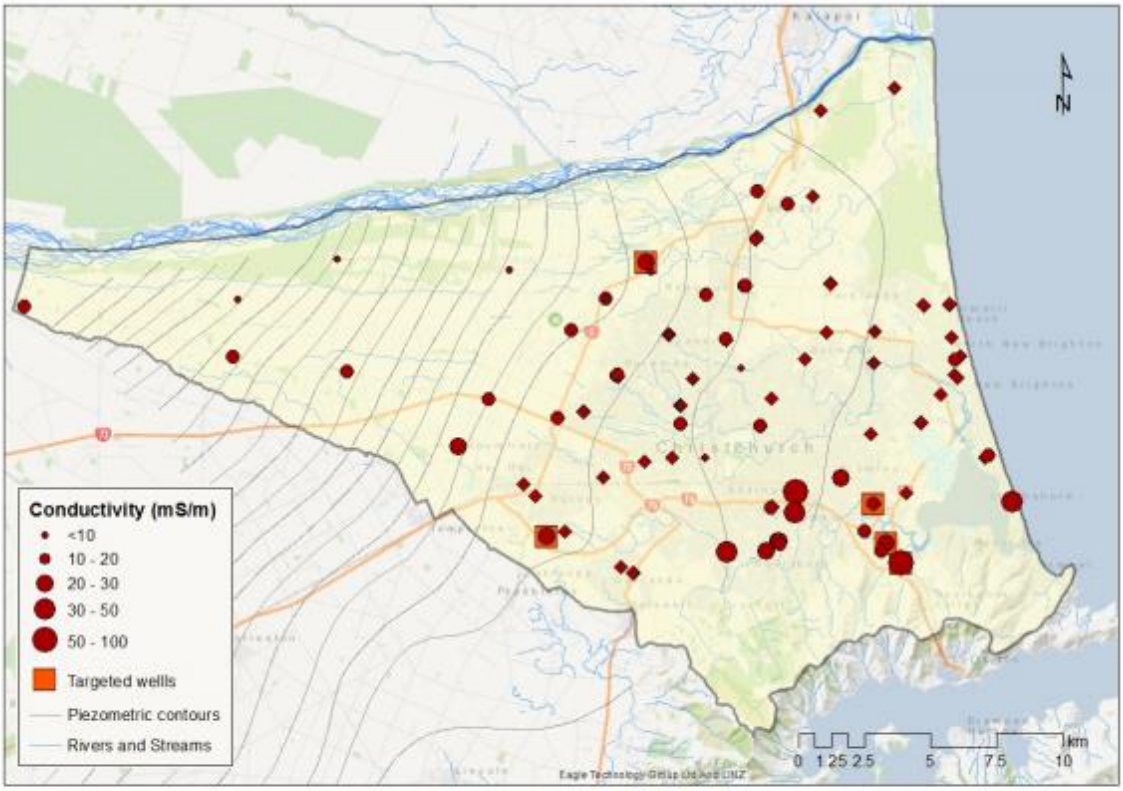

Figure 2: Distribution of groundwater conductivity in the Christchurch-West Melton CWMS zone (most recent sample for each well taken 2012 to 2015)

From Environment Canterbury Report Number R16/39, "Christchurch Groundwater Quality Monitoring 2015"