

Before The Queenstown Lakes District  
Council

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In the matter of            The Resource Management Act 1991

And                            The Queenstown Lakes District Proposed District Plan  
Topic 13 Queenstown Mapping – Group 1B (Queenstown  
Urban, Frankton and South))

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**SUMMARY EVIDENCE OF JEFF BRYANT FOR**

F S Mee Developments Co Limited (429)

Dated 14 August 2017

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**Counsel:**  
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Barrister  
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## **QUALIFICATIONS AND EXPERIENCE**

1. My full name is Jeffrey (Jeff) Martin Bryant. I am an engineering geologist with over 42 years' experience and hold the qualifications BSc (geology) from Victoria University and MSc (engineering geology) from Canterbury University.
2. I am a Fellow of the Geological Society (London) and by validation am entitled to the designation Chartered Geologist. I am also a member of the New Zealand Geotechnical Society and am affiliated through them to the International Association of Engineering Geologists.
3. My present employment is as principal, Geoconsulting Ltd, a geotechnical consulting business I set up in 1994. My business operates out of Queenstown.
4. Since 1983 I have had extensive experience throughout the Central Otago and Southern Lakes regions advising on roading projects, irrigation schemes, power schemes, building developments, subdivisional developments and other infrastructure projects.
5. Of particular relevance is my involvement with the new Kawarau Falls Bridge and associated southern approaches, site investigations and hearing evidence for the property to the east (Pt Lot 3 DP27200) and hazard assessment and hearing evidence for the property on the north side of Peninsula Road (Section 2 SO 448337).
6. In addition to providing geotechnical advice to civil engineering projects, I have often been called upon to provide advice on natural hazards affecting roads, walkways and river users on behalf of local and regional councils, DoC, Trails Trusts and land owners.
7. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

## **SCOPE OF EVIDENCE**

8. I have been asked by Counsel for the Submitter to prepare evidence in relation to a hazard assessment of the subject land and adjoining hillside above (Deer Park Heights). This includes:
  - a. Assessment of hazards identified on QLDC hazards register;

- b. Rockfall hazard assessment;
  - c. Suitability of proposed high density development zone.
9. My evidence is based on the following sources of information:
- a. Walkover survey of both High Density and Low Density Residential Zones.
  - b. Examination of aerial photographs (including stereoscopic pairs) and satellite images.
  - c. Review of previous Geoconsulting reports on properties to the south and east.

## **EXECUTIVE SUMMARY**

10. An assessment of natural hazards in so far as they relate to the proposed High Density Residential Zone has been undertaken covering not only the land within the zone but including the hillside extending up to the summit of Peninsula Hill. An initial step was to examine the records held on the QLDC webmap hazard register. No evidence could be found for any liquefaction or landslide hazard as described on this resource.

Rockfall potential was identified from the rock cliffs overlooking the site. Although boulders were found below the cliffs, their numbers dropped away with distance downslope and none were found in the proposed High Density Residential Zone. A combination of flat terraces and cross cutting gullies have provided a natural defence against boulders reaching the area of interest. It was concluded that there is a negligible risk of rockfalls affecting the Zone.

## **GEOMORPHOLOGY AND GEOLOGY**

11. The area of interest lies on the northern flank of Peninsula Hill and overlooks the Frankton Arm of Lake Wakatipu. The trough was formerly occupied by an arm of the Wakatipu Glacier which had its last advance about 12,000-15,000 years ago. Bedrock underlies the hills on either side of the valley and is exposed as steep bands of ice-smoothed rock ranging in slope from 45-90°.
12. Colluvium is derived from erosion of the rock cliffs upslope. The sand and gravel material is transported downslope initially by gravity and remobilised by rainfall runoff to be deposited on the lower, flatter slopes. Exposures of colluvium

immediately above and below the road clearly show water-laid deposits. Loess, a wind deposited silty fine sand, caps the colluvial deposits on lower slopes.

### **QLDC WEBMAP HAZARDS REGISTER**

13. The QLDC Hazards Register identifies broad categories of hazards based on some interpretation and generalisations centred round a knowledge of the underlying material type. Two hazards recognised as affecting this area are:
  - Landslide area - non verified.
  - Liquefaction risk – LIC1
14. No evidence could be found, either in the field or on aerial photographs, for any landslide in the area specified. Extensive bands of rock outcrop occur within the bounded area and these all have identical structure (i.e. foliation attitudes have similar orientation) indicating all outcrops are undisturbed and thus *in situ*. Accordingly, it can be concluded that the landslide hazard is non-existent.
15. Liquefaction susceptibility can apply to fine grained soils situated below the water table. No such sediments were found amongst the soil overburden during the field mapping. It can thus be concluded that the liquefaction hazard is non-existent.

### **ROCKFALL HAZARD ASSESSMENT**

16. Rockfalls are foreseeable yet unpredictable geologic events that the subject area is considered susceptible to. The presence of a source area for rockfalls and rocks that have clearly been transported from that source implies that further rockfalls can be foreseen. However, the following factors are of an unpredictable nature:
  - The timing and triggering of a rockfall event;
  - The position and volume of any failure;
  - The shape and size of any rocks, which governs the mobility and kinetic energy of blocks;
  - The degree of fragmentation occurring during transportation.
17. The rock cliffs overlooking the site are a potential source area stretching the width of the site and extending from around the upper boundary (RL 450 m) to the hill crest (RL 710-820 m). Similar conditions conducive to rockfall are also present for about 2.4 km along the north side of Peninsula Hill and affect (although not all

equally) about 100 homes along Peninsula Road alone. Although the faces have been smoothed by glacial action and have comparatively few defects, there are several scars from previous failures indicating that rockfalls are a very real hazard.

18. Field mapping undertaken as part of this study identified a number of rocks that have rolled or bounded down the hillside. Thick vegetation obscured the ground in places meaning not all fallen rocks could be mapped. The following observations were made from this exercise:

- The scree slopes beneath the cliffs are modest considering the size of the cliffs and are all well vegetated, i.e. they are not continuously being added to.
- No rocks were found on any of the tracks that traverse the property the earliest of which is understood to have been constructed in the 1980's.
- No rocks were found behind, nor damage to, the deer fence running along the top boundary of the boundary understood to have been constructed in 2008.
- Some rocks in the southeast of the property appear more likely to have been emplaced by landslide rather than transported there following rockfall.
- The frequency of rocks was greatest immediately below the cliffs and reduced with distance downslope. No rocks were found in the High Density Residential Zone.
- It is apparent that the many tracks and natural topographical traps such as gullies and terraces would act to limit the downslope transportation of rocks.

19. I have inferred from the above that rockfalls are an intermittent process occurring sporadically since the last glaciation when triggered by strong earthquake shaking or other environmental factors. There appears to have been no activity in the last few decades as seen by the lack of debris on tracks, the absence of paths through vegetation and the presence of lichen on all visible rocks. Mr Frank Mee advises that he couldn't recall any rockfalls on the farm since its purchase in 1960.

## **SUITABILITY OF PROPOSED HIGH DENSITY DEVELOPMENT ZONE**

20. The proposed zone is situated on the northern part of the property and is set as far away as possible from the rocky cliffs forming a backdrop to the site. Of key importance is the complete lack of rocks within the zone which suggests that the

zone is beyond the reach of mobile rocks. Furthermore, there is natural protection upslope in the form of gullies and terraces that would trap moving rocks. Development of the zone would include provision of a new access road around the upslope boundary which would also act as a trap. Additional protection could be provided by a two metre reinforced earth bund constructed alongside the road.

21. Overall, there appears to be negligible risk from rockfall to the proposed High Density Residential Zone. The new access road will provide further protection and it would be feasible to augment that with a bund if necessary.

**DATED this 14<sup>TH</sup> day of August 2017**

**Jeff Bryant**